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ERRATA.

Page 13 line 8 from foot, delete *Halleria lucida*.
„ 14 „ 8, for *Eriosema shirensis* read *Eriosema shirense*.
„ 16 „ 10, *for* " tecto " *read* " tectum."
„ 17 „ 16, delete *E. G. Baker*.
„ 51 „ 27, for *G. E. Baker* read *E. G. Baker*.
„ 61 „ 18, for ZAMBESIANA read ZAMBESIACA.
„ 143 „ 29 for COARTATA read COARCTATA.
„ 145 „ 3, *for* 1895 *read* 1905.
„ 199, last line, for *A. Rich.*, read *Hochst.*
„ 248 line 6 from foot, for *V. Bidwillii*, Hook. f., read *V. Bidwillii*, Hook.
„ 308 „ 9, for *Acanthoccocus*, read *Acanthococcus*.
„ 333 „ 10 „ „ for TENUISSIMUM read TENUISSIMA.
„ 333 „ 13 „ „ for GLAUCUM read GLAUCA.
„ 362 „ 14 „ „ for *Eurynchium* read *Eurhynchium*.
„ 381 „ 21 *for* Spondylium *read* Sphondylium.
„ 400 „ 13 from foot, for *lucustris* read *lacustris*.

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A CONTRIBUTION TO OUR KNOWLEDGE OF THE FLORA OF GAZALAND: being an Account of Collections made by C. F. M. Swynnerton, Esq., F.L.S. By Dr. A. B. RENDLE, F.R.S., F.L.S., Mr. E. G. BAKER, F.L.S., Mr. S. MOORE, F.L.S., and Mr. A. GEPP, F.L.S.; with Notes by Mr. SWYNNERTON.

(PLATES 1–7.)

[Read 2nd June, 1910.]

THE collections which form the subject of this paper were made by Mr. Swynnerton chiefly in the high country which forms the boundary between Eastern Rhodesia and Portuguese territory. The following account of the district, which has been compiled from Mr. Swynnerton's notes, will give some idea of its general character and vegetation. Mr. Swynnerton also collected in the lower lying country within the Portuguese boundary, especially in the Madanda Forest and along the Buzi River, which enters the Indian Ocean opposite Beira.

We know but little of the special characters of the flora of the highlands on the Anglo-Portuguese boundary. Archdeacon Johnson collected on the Chimanimani Mountains, and some of his specimens, which are in the Kew Herbarium, are identical with plants in Mr. Swynnerton's collection.

Mr. Swynnerton's Account of his Expedition.

The tract that we commonly call Gazaland extends roughly from some distance to the south of Delagoa Bay to the Umvumvumvu, Lusitu, and Buzi rivers, the sea bounding it on the east and the River Sabi on the west.

Quite the most varied and striking portion of the country thus defined is the Melsetter district of South-Eastern Rhodesia, with those portions of Portuguese territory which immediately adjoin it. Approaching it southwards from Umtali, and already well acquainted with other parts of Rhodesia, we were at once struck with the immense change in the appearance of the country which we found on crossing the River Umvumvumvu. For two days we tramped monotonously through a barren though picturesque wilderness of "kopjes," covered with the ubiquitous "Mutsatsa" (*Brachystegia Bragaei*, Harms), and topped invariably with the enormous granite boulders that are so universal a feature of the Rhodesian landscape. But nothing on our journey resembled in the least the great green mountains which spring into view when we reach the dividing river, with their dense short turf immensely rich in wild flowers, their heavily wooded gorges, and their rushing perennial streams in every glen. The walk into Melsetter over these mountains occupied nearly two days until, on reaching the high ridge that overhangs the little township, we came into full view of the magnificent range of the Chimanimani, with its bold peaks, precipices and chasms, towering up through the clouds and separating the Portuguese district of Shaya from the grassy mountains of Melsetter.

I visited this range in September, 1906. After a tramp chiefly downhill over the open grassy slopes separating Melsetter from the River Haroni—here a mere rivulet, but, before it joins the Lusitu, an immense torrent cutting its noisy way through the deepest and most precipitous gorge in the country—I commenced the ascent, at first over grassy but recently burnt foothills scantily clothed with open woods of *Brachystegia* or very occasionally with denser clumps of *Uapaca Kirkiana.* They culminated in a very broken steep rocky ascent, and on surmounting this I found myself forced to descend once more through a valley clothed with grass and dotted over with plants of *Syzygium cordifolium* before I could commence the first steep ascent of what still appeared to be part of the main range. This consisted of a long rugged line of towering white crags broken here and there by a chasm or densely-wooded precipitous ravine; the valley had here developed into a deep sharp gorge thickly clothed with trees. Through a steep, narrow, boulder-strewn passage flanked by towering cliffs and giving egress to a small stream that flowed from a dense forest-patch at its head, I eventually found my way to a broad turf-covered ledge near their summit, where I camped for the night beside a clump of four Brachystegias.

Towards morning the weather suddenly changed, and in a few minutes everything was thoroughly soaked. Nevertheless, wandering about the face of the crag in a dense Scotch mist, and clambering from one narrow ledge to another, I succeeded, in such spots as had proved inaccessible to the recent grass-fires, and especially in a deeply-cut chimney in the face of the rock, in getting together quite a number of plants, most of which were unfamiliar to me, amongst them three heaths that have since proved to be new to science. An orchid with reddish fleshy leaves, not in flower, hung everywhere from the rocks, and in some parts a small aloe (perhaps *Aloë rhodesiana*) grew on the ledges, many of which were exceedingly rich in ferns. When later in the day the mists rose, I discovered that I was standing on a grassy ridge with the highest peaks nearly as far away as ever, separated from me by a valley yet broader and more broken than the first. However, in the immediate vicinity were two dense and most attractive-looking forest-patches and a splendid wooded gorge. Nearly everything was in flower, with the result that, though my visit was brought to a speedy close by the continuance of the bad weather, I got together a very representative little collection. The "cedar," *Widdringtonia Whytei*, was decidedly the most interesting of the larger trees. It is fairly common on the edges of wooded gorges and dense forest-patches throughout the higher portions of Northern Melsetter, but never attains here the enormous size described by Whyte for those of the Milanji range. In general these mountain forests, though dense and rich and composed largely of evergreen trees, are far lower and less striking than those of Southern Melsetter. The trees average little more than forty feet in height, and the most characteristic are the large dark-leaved *Cussonia umbellifera, Aphloia theæiformis, Curtisia faginea*, and two species of *Faurea*; and, on Mount Pene, a good-sized straight-growing *Mæsa* (*M. lanceolata*, a narrow-leaved form very different in appearance from *M. lanceolata* of Southern Melsetter) and large specimens of *Eugenia owariensis*. This mountain, Pene, or, as it is more commonly called, Singwekwe, is separated from the Chimanimani by the gorge of the Haroni, and with its single grassy peak, 7000 feet above sea-level, forms quite a landmark throughout the district. I visited it on the following day and again in October 1908, and have never anywhere seen such masses of colour in the form of wild flowers as I found on both occasions on its high turfy slopes. In the stonier places were numbers of a new *Anemone* (*A. peneensis*). There are clumps of fine Strelitzias at the heads of many of the glens, and the wood covering its eastern face is, especially towards the summit, one of the best examples of mountain forest I have seen and contains fine specimens of a large *Podocarpus* (*P. milanjiana*), of which I had already found young trees in flower on the Chimanimani. Curiously enough there appear to be no "cedars" here. The large thick-trunked

Conopharyngia Stapfiana, with handsome white flowers, is also characteristic of the higher portions of the mountain, while in a sheltered spot a few hundred feet down a number of the common Melsetter *Philippia* (*P. Simii*) attained a quite unusual size, being thirty feet or more in height. The undergrowth is rich and varied, the most noticeable species being *Cephalanthus natalensis*, with its edible raspberry-like fruit, while a handsome *Aphloia* with creamy flowers (*A. theæformis*), beds of ferns and mosses border the streams that wind down to the Haroni and Lusitu. The actual summit of the mountain is extremely stony and partly covered with a dense growth of fleshy-leaved aloes, and it is from this point more than from any other in the district that a good general idea of the varied nature of the country can be obtained. To the east is spread out the whole rugged Chimanimani, cut off almost abruptly at its southern end by a fall of several thousand feet into the Haroni-Lusitu gorge. To the north and west are the grassy mountains of Northern Melsetter already described. To the south-west, separated from us by the deeply-cut gorge of the Lusitu, are the lower and more rolling hills of Southern Melsetter, with their long grass, dotted with stunted clumps of *Parinarium*, their occasional open woods of *Brachystegia* and many other trees of similar growth, their fine perennial streams, and, especially on the eastern border, which catches the bulk of the rainfall, occasional handsome forest-patches. The general elevation of this piece of country varies from 3000 to 4000 feet.

Turning to the south-east, we find spread out far below us the yet lower jungle-covered hills of the Mafusi and Makwiana country across the Portuguese border, a great square tract which includes the broad flat Chikambogé valley. This tract is bounded far to the south by the Buzi River, and on the east by the fine precipitous Sitatonga Hills, far lower than the Chimanimani, but by their isolation almost as striking. Their eastern face is covered with dense and fairly high forest abounding in elephants, and descends (far more gradually than on the western side) through an unusually bad tsetse-fly area into the low veldt proper. On the occasion of my visit to that portion of the lowlands in June 1900, I unfortunately did no botanising, but I remember being struck by the unusual wealth of water-lilies (of our common blue species) which filled the large pools of the Amanzimhlope water east of the Sitatonga Forest, as well as by the fineness of a few of the palms (*Hyphæne ventricosa*) of the same neighbourhood. The open woods which covered the rest of the country beyond the forest, and which at the time of my visit abounded in large game, were of much the same type as those which I shall describe for the country to the south of the River Buzi.

The Mafusi tract, except for a few of the higher hills on the Anglo-Portuguese border, contains, in addition to three or four handsome but small forest-patches, a good deal of dense bush. This is exploited annually by the

Mozambique Government for the rubber (chiefly *Landolphia Kirkii*) that it contains. In the actual grass-jungle the chief tree seen is an *Acacia*, and it is to this species and to *Markhamia lanata*, of the denser bush, that the natives of the locality go for their bark cord ; for there is no *Brachystegia* to be found anywhere here excepting on the Sitatongas. Approaching Maruma through the Chikambogé valley, the country becomes hillier and the growth of thorns denser but more intermixed with other trees. Finally, having passed Mpengo and Maruma, both comparatively small but striking hills, their eastern faces clothed with high forest, and having surmounted Umtereni, itself open grass with an occasional patch of dense bush, we find ourselves, on descending its southern slopes to the Buzi, in bush of a very different type. This consists of open woods of species of *Uapaca*, *Brachystegia*, *Afzelia*, etc., commonly found throughout Rhodesia, but of quite unusually fine growth, such as I have only seen elsewhere on parts of the Chikore Hills and in a narrow strip bordering the eastern edge of the Sitatonga Forest. We now cross the Buzi, here already a river, and bordered often, as are most of the foothill streams of Mafusi, Makwiana, and the Jihu, by "Redwoods" and "Mahoganies" (*Adina microcephala* and *Khaya nyasica*) of magnificent growth. An unusually hot tramp through the Inyamadzi gorge and up its steep southern slope, covered with high grass-jungle, now brings us into full view of Chirinda and its satellite Chipete. "Chirinda," with the not inappropriate meaning of "The Great Sleep," is the name given by the natives to a virgin forest composed of enormous and mostly evergreen trees that covers roughly 12,000 acres of the higher portions of a hill 65 miles by road to the south of Melsetter. Its larger trees range in height from 80 feet in such species as *Gardenia tigrina* and a new *Croton* (*C. Swynnertonii*) and *Ehretia divaricata*, to the 130 feet or more of *Khaya nyasica*, a new *Trichilia* (*T. chirindensis*), *Strychnos mitis*, *Schefflerodendron gazense*, and several other equally magnificent species. A fallen *Lovoa* (and to judge by its trunk-diameter by no means a large one) measured 170 feet, and its smaller twigs, had they been still present, would have added at least another 15 feet to its height. Clean boles of 90 feet without a branch are by no means exceptional either in this species or in the yet commoner *Maba Mualala*, which, with its almost black bark and extraordinarily straight slender trunk branching only at the very top, is not only one of the tallest but one of the most striking trees of the forest. Parasitic figs with broad shady crowns are, from the forester's point of view, only too common, their wonderfully picturesque open-work trunks, one of which measured no less than 21 feet in diameter, usually still upholding the strangled remains of their victims. Altogether a dense canopy is formed high overhead, shading effectually the mass of mostly evergreen saplings and shrubs that form the undergrowth. They include a wild orange with highly-coloured fruits, a

pepper, the aromatic fruits of which have been found excellent for flavouring, and a coffee of fine quality, while by far the commonest species are a *Macrorungia* and an *Achyrospermum*, each a gorgeous mass of red or crimson in its flowering-season. Underfoot is a soft carpet of mosses, various ferns, a short broad-bladed grass, and other plants peculiar to such shaded situations; and here and there amongst the undergrowth are clumps of a handsome *Dracæna*, which are favourite nesting-places of the smaller forest-birds and give a thoroughly tropical appearance to the surroundings. Huge woody lianas, notably a large *Oncinotis* with a striking rough ochreous bark, add to this impression, climbing to the tops of the highest trees, hanging in festoons from branch to branch, and twisting round the tree-trunks and each other in fantastic fashion; while orchids, epiphytic ferns and mistletoe hang in picturesque masses from the moss-grown trunks and branches of the larger trees.

Chipete with an area of 40 acres, though originally doubtless part of Chirinda and separated from it now only by a grassy glen a few hundred yards in width, differs from it in the absence of many of its finer and commoner trees, such as *Khaya nyasica* and *Lovoa Swynnertonii*, in the far greater abundance of *Landolphia Swynnertonii*—old hoary trunks evidently of immense age,—and of the forest coffee, which here forms the main undergrowth; it also possesses, in common with Maruma, a fine *Bosquiea* (*B. Phoberos*) which I have not found in Chirinda.

Maruma, Mpengo, and nearly all the other small forest-patches and more heavily-wooded glens of the district differ from both in lacking most of the characteristic larger trees of Chirinda, and in having frequently for their dominant species *Piptadenia Buchananii*, which is comparatively rare in Chirinda and entirely absent in Chipete and often attains an enormous height and girth. Nevertheless there are many indications that all these isolated forest-patches, reduced now in most instances to extremely small dimensions, and even single trees, surrounded by the charred remnants of their companions, may be regarded as the survivors of a great general forest which in the course of centuries has been driven back from the lower slopes by grass-fires, which doubtless obtained their original grip on the forest lands during some period of dense native population. The rich soil so frequently found on high ridges and hill-tops contrasts with the comparative poverty of the surrounding slopes and valleys, and, taken in conjunction with the actual position of the majority of the existing patches, points to a general survival of forest in such situations at a comparatively recent date; and it is probably not very long, as such periods go, since a large tract of country, comprising the south-eastern foothills and still receiving the heaviest rainfall (80 inches), was wholly clothed by an extensive forest of which only the culminating points survive. Chirinda itself still suffers considerably from

fire, and the abrupt cliff of old trees which it presents on its south-eastern faces to the prevailing winds (and consequently fires) forms a suggestive contrast to the fringe of young growth to be seen on its more sheltered edges.

The Umswirizwi River rises on Gungunyana at the foot of a high hill, Mount Marozwi, just to the north-east of Chirinda, and, flowing at first due west through grass-country and open woods, drops gradually into a deep gorge and carries us on to the heavily but openly wooded Chikore Hills. These, a little further east, culminate in the heights (4000 feet) that overlook the enormously broad Sabi Valley and command a view far across the river of the extremely broken "Kopje" country of the eastern Victoria district, famous for its Zimbabwe ruins. The Sabi is here a broad shallow sand-stream flowing at an elevation of about 1000 feet, and the flats that border it are said to be in many places magnificently wooded, in spite of a usually small rainfall.

South of Chirinda and for the most part in the Portuguese district of Mossurize, is an extensive and somewhat unique tract named the Jihu. This name, properly applied to a rich red dioritic soil and a rank grass (*Andropogon* sp.) which commonly grows on it, has in this case been transferred to a piece of country of which these are the chief characteristics. It is bounded on the west roughly by the Umswirizwi, which turns south before reaching the Chikore Hills, on the south by Mount Singuno and the other hills of the same range that suddenly fall away into the Umswirizwi flats, and on the north-west (though the Mafusi country is in reality a northward continuation of it) by the Buzi. It is watered mainly by three small rivers, the Kurumadzi, rising at Spungabera, and the Zona and Chinyika, rising in Chirinda, the first two flowing into the third. Its soil, which is immensely rich in humus, considered together with the scattered but unmistakable traces of forest destruction which I have come across, would seem to show that the whole of the Jihu was once under first-class timber. At present it boasts, I think, only three small forest remnants, themselves rapidly disappearing under the devastating effect of the annual fires. Otherwise it is covered from end to end with a tall dense growth of *Andropogon* and other rank grasses and shrubs, matted into an impenetrable jungle by *Mucuna*, *Smilax Kraussiana*, *Dioscorea*, and other tough and for the most part thorny climbers, and interspersed, sometimes thickly, but more usually somewhat sparsely, with two species of *Acacia* and other trees of some size, but especially with *Pterocarpus sericeus*, and in parts *Ormosia angolensis*. The most notable feature, however, of the actual grass-jungle is perhaps the masses of *Leonotis mollissima*, scattered throughout it and extraordinarily attractive to all kinds of birds. The grass of the moister parts is shorter and much frequented by buffaloes, and the Jihu is seldom entirely free from lions. Here and there

one meets with dense thickets of *Brachylæna*, *Conopharyngia*, *Markhamia* and other trees, but *Landolphia* is rare.

The above description, with the exception of the last sentence, would apply almost as well to the vegetation of the Chikambogé Valley and a great part of the Mafusi district. It may give a clearer idea of this type of jungle if I state that, in order to get about when I was locating a concession on the Kurumadzi, we had to cut our way everywhere with axes and hoes, and the backs of my men were often pouring with blood, the intense irritation of the "buffalo-beans" (*Mucuna coriacea*) which clustered everywhere in the tall grass and bush, forcing them to scrape themselves with sticks and sharp-edged stones as their velvety stings fell in showers on them.

At the northern edge of the Jihu, and only eight miles by path to the south-east of Chirinda, are the Spungabera forest-patches, notable for some splendid specimens of *Chrysophyllum fulvum*.

Leaving Chirinda on November 18th, I was rained up on the Kurumadzi and could do but little collecting, but on the first fine afternoon pushed on past the Chinyika river and Mount Singuno to the flats of the Umswirizwi; for the latter, which had now to be crossed, had taken yet another sharp turn, this time from west to east. It keeps this direction till it finally joins the Buzi, having meantime in its circuitous course received every water that flows from Chirinda.

The vegetation between the Chinyika and Singuno was extraordinarily rank and dense, even for the Jihu. Consequently the contrast was all the more marked when, on crossing a small stream halfway down the hill, we found its banks lined by huge *Khayas* and the typical Jihu vegetation, at that point sharply separate from that of the valley below. A little higher up I had already noted the first few *Holarrhena febrifuga* and some of the taller forms, such as *Bridelia*, continued down for a short distance, but they rapidly mingle with and give place to *Diplorhynchus mossambicensis*, a *Terminalia*, and a *Combretum*, *Securidaca*, and other forms of which I should soon see more. *Ormosia angolensis* remains, however, one of the commonest trees. The change in the grass was more abrupt and striking, for from here onward it was only 6 or 8 feet high—later still less—and free from intermixture with *Mucuna*, etc. The "Idema," a *Dolichos* (probably *D. brachypus*), much used by the natives for poisoning fish, is common, and four species of *Bauhinia* are found in the valley (*B. Galpini*, *B. reticulata*, *B. fassoglensis*, and *B. Petersiana*), where the soil, though still fertile in good rainy seasons, and supporting, twenty years ago, a large native population, is full of stones and boulders. The open bush of the valley is mostly stunted, and it was not till I reached the river that I found any good tree-growth. Here, lining the banks, were fine specimens of *Kigelia* and *Sterculia Triphaca*, *Trichilia umbrifera*, as well as many more familiar species such as *Khaya nyasica*. A steep stony

ascent now brought us to the top of the Zinyumbo Hills, which are covered with comparatively short grass and stunted scattered bush, but the *Khaya* and *Erythrina tomentosa* occurred along a dry watercourse. On once more descending towards the Mwangezi River the vegetation became far richer. The river itself is a typical African stream, with great muddy pools surrounded by rock and mud-banks and connected only by a trickle, but the banks were bright green with the dense and luscious growth of a species of *Sorghum*. From Singuno right through to Chimbuya, which is three miles east of the Mwangezi, *Diplorhynchus mossambicensis* was common and in many parts the dominant tree, but from Zinyumbo's Kraal on *Dalbergia melanoxylon* became fairly abundant, while throughout the hills *Bauhinia reticulata*, mostly stunted, and *Bauhinia Galpini* were present in considerable numbers, to say nothing of an ubiquitous *Combretum*. A palm, *Hyphæne ventricosa*, in a stunted form was first noticed on the Zinyumbo Hills, but I met with the first really good specimens with a bulge in the stem at Chimbuya.

From here on to Inyajena's Kraal the whole country was flat or slightly undulating and covered with open bush, sometimes tall, sometimes low, but never dense, and the soil was a black alluvial, lightening in the higher parts to a deep chocolate-brown with frequent outcrops throughout of reddish water-worn stone and gravel with quartz. The few dry stream-beds crossed were marked by larger and darker-green trees, not so fine however as on the Umswirizwi. On crossing the Umtefu, dry except for one or two small pools, the vegetation became more familiar, consisting chiefly of *Acacia caffra* and *Bauhinia reticulata*, with some Albizzias and a few fair-sized trees of *Peltophorum africanum*, *Kigelia*, and other species. From the Umtefu to Inyajena and on thence for a short distance, the soil is entirely of the black alluvial type, and must be very swampy in the rains. The whole country was now thoroughly parched up and the heat was intense, the scattered dry bush affording no shade whatsoever. *Acacia caffra* was on the whole the commonest tree, but a *Combretum* was present in considerable numbers. However, on reaching Chibabava we for the first time struck the Buzi River, and the vegetation at once underwent a change. *Acacia caffra* was still very common, and an occasional big baobab (*Adansonia*) was seen; but on the rich soil that extended back for some distance from the river were numbers of magnificent spreading and shady trees of *Trichilia emetica*, *Sterculia*, *Triphaca*, *Kigelia*, *Lecaniodiscus*, and other genera, while the actual steep river-bank, here in many parts about 40 feet high, was clothed sometimes with a rich growth of *Sorghum*, *Anatherum muricatum*, etc., sometimes with dense thickets of *Grewia*, a *Croton*, and other small trees and climbers. The water's edge and the small islands in the river were often covered with a growth of tall reeds and *Sesbania punctata*, the twigs of the latter thickly hung with the nests of weaver-birds (*Hyphantornis aureus*

and *nigriceps*). Amongst the commoner trees of the open bush of this neighbourhood were *Acacia caffra*, an *Albizzia*, an *Odina*, *Dalbergia melanoxylon*, *Bauhinia reticulata*, *Tamarindus indicus*, a *Combretum*, *Strychnos Burtoni*, a *Millettia*, and *Lonchocarpus violaceus*. Few of them reached, I should say, more than 40 feet in height, while in many parts they were much lower, which may be taken to apply to nearly all the better-grown bush of those parts of the lowlands through which I have passed. The common shrubs included *Anona senegalensis*, *Peltophorum africanum* (perhaps better placed amongst the trees), *Vangueria edulis*, and *Flacourtia hirtiuscula*.

I also paid a short visit to the Madanda rubber-forests. The open woods, which extend with only an occasional slight break all the way from Chibabava to Arucate, the collecting station on the edge of the rubber-forests, were varied and for the most part composed of much the same species as I had met with round the former place. *Acacia caffra* and especially a *Combretum* were particularly abundant, though *Holarrhena febrifuga* also occurred in numbers, its great masses of white blossom making quite a flower-garden of the woods. However, eight or nine miles south of Bimba I was surprised to find intermixed with the commoner species of the lowlands a number of such high-veldt species as *Ormosia angolensis*, *Conopharyngia elegans*, and *Gardenia asperula*, these three all in flower. I also passed a number of *Pterocarpus angolensis*, the first seen since leaving Chirinda. Approaching Arucate the country became more broken up into hollows, likely to be swampy in the rains, and dried-up pools appeared, while the bush in general became smaller and more scattered. That immediately round the station at Arucate chiefly consists of *Brachystegia*, mingled, especially on the large ant-heaps that abound there, with a *Grewia* (*G. madandensis*), a *Vitex*, and other trees and shrubs. The soil is light grey and very sandy, both here and through a great part of the actual rubber-forests.

These forests are, at all events in Butiro's country, simply very dense bush averaging little more than 25 feet in height, and composed largely of such low-growing trees as *Crossopteryx Kotschyana* and *Erythroxylon emarginatum*, the whole being bound together with a tangle of woody climbers such as *Landolphia Kirkii*, here exceedingly abundant, *Secamone zambesiaca*, a Landolphia-like *Salacia*, and various Anonaceous plants. An occasional slightly larger tree, such as *Monodora Junodi*, projects above the general level. I found a coffee, probably identical with that which occurs in considerable quantity on the Juababa stream (which flows into the Umswirizwi from the south), and grows, both wild and cultivated, on portions of the coast. I was informed that, though there is a comparatively small area of larger forest in Makupi's country, what I saw was typical of the whole of these rubber-forests.

On my return to Chibabava (elevation about 400 feet) I pushed on towards Beira. A few miles out we passed some fine pools and a certain amount of

dense bush, but on the whole the trees from Chibabava to Muchukwana, 18 miles, remained much the same as those I have already enumerated. From here on to Chironda I met with a certain amount of *Hyphæne ventricosa*, but recognised little besides except *Lecaniodiscus fraxinifolia*, *Acacia caffra*, and the *Holarrhena*, *Ehretia*, and *Vangueria* already mentioned. It was a decidedly broken piece of country and inferior in point of woods to that which I had just left. At Chironda the formation is a nummulitic limestone. This is still more in evidence about Boka and the Idunda River, and supports a good deal of dense bush, largely composed of species which I did not meet with elsewhere, although there was no marked change in the character of the open woods. A *Millettia* and *Erythroxylon emarginatum* were common in the denser patches at Chironda, and I also noted several other species which I had already collected in the Madanda; but possibly the commonest and certainly the most striking shrub in flower at the time was *Pavetta saligna*, S. Moore. The journey from here was mostly downhill, and for some distance through fine, big, open bush containing a large proportion of "Mukwakwa" (*Strychnos Burtoni*), the fruits of which are extensively used by the natives as food, also a fine latex-yielding tree with handsome red fruits exactly resembling those of *Carissa grandiflora*, both in external and internal appearance and taste; it has, however, only one large seed. Curiously enough, it is known to the local natives by the same name as that which the Zulus of Natal apply to that *Carissa*—"Umtungulu."

Some of the dense bush at Boka is very attractive. I saw some fine *Khayas*, a *Millettia*, a *Croton*, and an *Oxyanthus* the foliage of which I was unable to distinguish from that of some of our Chirinda species, while the undergrowth was largely composed of an *Isoglossa* identical in general appearance with *I. mossambicensis* of Chirinda. A short distance on, we crossed a beautiful clear limestone stream, the Idunda, with quite a large volume of water, and at once entered a fine piece of forest containing, amongst various species which I did not recognise and of which I was unable to obtain the flowers, some good-sized specimens of *Khaya nyasica* and a number of very striking *Sterculias* with tall, straight, perfectly smooth greenish stems, rising to a great height before branching. From here on our path largely followed the river, which had quite changed its character since I last saw it, flowing now over a broad sandy bed and easily navigable to native dug-out canoes and probably larger craft. The trees were large, containing a fair proportion of palms, *Kigelia*, *Trichilia*, and other fine species, which grew often in clumps and gave the country a most park-like appearance. The natives here live largely by fishing, and had in many instances planted mango, cashew-nut, and Céara rubber-trees about their villages. A *Brachystegia* and *Diplorhynchus mossambicensis* were amongst other species not uncommon. A little further on, on ground that would have been swampy in the rains, I passed a large number of the *Acacia* known

on the coast as the "fever-tree," with its sickly-looking yellow bark and almost leafless twigs. Finally, after a hot tramp over comparatively barren country covered sparsely with a palm (*Hyphæne ventricosa*), mostly small *Bauhinia reticulata*, and, above all, a *Combretum* in a stunted form, I reached the Kraal of Inyamita. The river at this point is very broad and contains numerous islets, but its banks are largely inaccessible owing to dense reed-beds. A short journey through more open grass country with chiefly introduced trees such as mangoes and oranges, some of them very old and stately, brought us to the Malata rubber, coco-nut, and sugar estate, whence it was a half-day's sail in a small boat to Beira.

Here I did a little collecting; the beach itself is surprisingly rich in things which one finds commonly growing in the bush about Arucate and Chibabava. Next comes a strip of bare open grass-land, part of it more or less covered at high tide and supporting in places a dense but low growth of mangroves; but four or five miles inland real open woods commence. These are composed of an admixture of typical low-veldt species with many of our commonest trees of the highlands. Collecting here on Christmas-day, I noted amongst others an *Albizzia*, probably *A. fastigiata*, a *Parinarium*, *Vitex Cienkowskii*, *Uapaca Kirkiana*, *Acacia caffra*, *Eugenia owariensis* forma *latifolia*, two species of *Ficus*, a *Ximenia* with edible fruits, *Smilax Kraussiana*, *Landolphia Kirkii*, and *Anona senegalensis*.

Excepting for a slight shower at Zinyumbo and another at Beira, not a drop of rain had fallen during my journey and stay in the low veldt. I consequently found the country completely parched on my return journey, while in many parts swarms of larval migratory locusts were doing great damage to such low vegetation as was still green; yet the Umswirizwi, when I reached it, was in full flood. The greenness and luxuriance of the vegetation in the Jihu formed an extraordinary contrast to the bareness of the country I had just passed through. On reaching Chirinda on January 10th, I was informed that it had rained steadily ever since I left, an all-sufficient reason for the vast difference in the flora of the high veldt and the low. The grass throughout the lowlands is, I may here mention, short and very unlike that prevailing throughout Southern Melsetter and the Mafusi and Jihu districts. As to temperature, I have at Chibabava seen the glass standing at 108·5° Fahr. at 4 P.M. in a particularly cool thatched hut with a breeze blowing straight through, and it must frequently have been far higher at noon. During the same two months of 1908–1909 the highest point reached in my veranda at Chirinda was 79·5° at 1.30 P.M. on December 15th, the average noon reading for that period being nearer 69° Fahr. Northern Melsetter is naturally yet cooler, in fact in the winter bitterly cold, frosts being then of daily occurrence.

The collection has proved rich in novelties, especially among the Gamopetalous orders of Dicotyledons, to which belongs the one new genus, *Swynnertonia*, a member of the order Asclepiadaceæ. There are a large number of Rubiaceæ new to science, especially in the genera *Gardenia* and *Pavetta*; several new *Senecios* and *Helichrysums*; some new heaths, several new Acanthaceæ, and others. Among the new Labiatæ is a magnificent *Leonotis* (*L. spectabilis*) from Chimanimani. Among the Polypetalous orders the new Meliaceæ are especially noticeable; mention of these will be made in the paragraph dealing with the trees. An *Anemone* (*A. peneensis*) from Mt. Pene, with white flowers, is a showy plant and is in some respects intermediate between the two genera *Anemone* and *Knowltonia*. A new *Polygala* from the Chimanimani Mts. is allied to the South-African *P. peduncularis*. There are also several new species of *Grewia*. The remaining novelties among the Polypetalæ are for the most part members of well-known African genera. Other interesting novelties are a new *Protea*, a new *Corrigiola* (*C. drymarioides*), and a *Leucospermum* (*L. saxosum*) from the Chimanimani Mts., the first record for this well-known South-African genus within the tropics.

The Monocotyledons include several new Orchids in well-known African genera such as *Eulophia* and *Angræcum*, and a number of new Liliaceæ and other petaloid groups. Also several new grasses, including a new species of the small Madagascar genus *Pœcilostachys* and of *Craspedorhachis*, a small genus with two species confined to the Zambesi country.

As was to be expected from the geographical position, the botany of these highlands shows a strong South-African affinity, and several of the genera noted have not been hitherto recorded within the tropics. Such are the four genera of Scrophulariaceæ, *Freylinia*, *Teedia*, *Zaluzianskya*, and *Bopusia*, the first of which is represented by a new species (*F. tropica*), the remaining three by previously known South-African species. *Galopina* (in Rubiaceæ) belongs to the same category, and also the Liliaceous *Behnia*, Mr. Swynnerton having collected the well-known *B. reticulata* in several localities. A considerable number of species hitherto only known as South African occur in the collection. Many of these are natives of the Transvaal and Natal, but some are more widely distributed Cape species. Under this latter category may be enumerated *Curtisia faginea*, *Bopusia scabra*, *Halleria lucida*, *Teedia lucida*, and *Zaluzianskya capensis*. Indication of a floral connection with the more northerly highlands is found in such plants as *Cuscuta kilimanjari*, a species of dodder hitherto known only from Mt. Kilimanjaro but found by Mr. Swynnerton on Mt. Chirinda at 3800 feet, and an orchid, *Habenaria pedicellaris*, from the Upper Buzi (at 3000 feet elevation), which is also found on Mt. Kilimanjaro and in Abyssinia; *Dioscoreophyllum chirindense* has a distinct alliance with a Kilimanjaro species.

As was also to be expected, a large proportion of the plants is identical with those previously known from Nyasaland. Such, for instance, is the Milanji "cedar" (*Widdringtonia Whytei*), which apparently finds its southern limit of distribution on these highlands, where, though plentiful in places, it is a smaller tree than on Mt. Milanji. Several orchids illustrate the same distribution; such are *Lissochilus papilionaceus*, *Satyrium Buchananii*, *S. occultum*, and *Disa hamatopetala*. To the same category belong *Dioscorea Buchanani*, *Hibiscus shirensis*, *Khaya nyasica*, *Eriosema shirensis*, *Piptadenia Buchanani*, *Anthocleista zambesiaca*, *Nuxia sambesina*, and many others. A good many of the species range more or less widely over East Tropical Africa, while another element of the flora embraces South Tropical African species which do not occur north of the Zambesi.

There is also an Angolan element represented by such species as *Asparagus angolensis*, a grass, *Eragrostis Hierniana*, *Maba Mualala* (Ebenaceæ), and *Pseudolachnostylis Dekindtii* (Euphorbiaceæ), etc. An interesting novelty is *Pseudocalyx africanus*, *Pseudocalyx* being a Madagascar genus not hitherto known from Tropical Africa; and a new grass, *Pœcilostachys flaccidula*, is another example of the extension of range of distribution of a genus hitherto recorded only from Madagascar.

There are a number of very fine trees in the Gazaland forests, some of them yielding excellent and valuable timber. These belong mostly to the families Meliaceæ, Sapindaceæ, Leguminosæ, Combretaceæ, Sapotaceæ, Loganiaceæ, Euphorbiaceæ, and Urticaceæ. Among the Meliaceæ may be noted *Ekebergia Meyeri*, which is a large handsome tree reaching a height of 90 feet; *E. arborea* is a smaller tree only reaching 30 feet, but it is much used by the natives for the manufacture of pillows and bowls. *Trichilia umbrifera* is a huge tree growing on the banks of the river; *T. chirindensis* is also a huge tree attaining a height of 120 feet; *Lovoa Swynnertonii* attains the even greater height of 160 feet, and *Khaya nyasica*, allied to the well-known *K. senegalensis*, reaches 150 feet. Among the Celastrineæ may be noted the Chirinda Redwood, *Catha edulis*: it is one of the largest forest trees, with very rough bark and handsome timber. Among the Sapindaceæ are *Phialodiscus plurijugatus*, which also occurs in Angola, *Lecaniodiscus fraxinifolia*, and *Bersama Swynnertonii*, and a form of *Bersama nyassæ*. Among the Leguminosæ are *Schefflerodendron gazense*, one of the largest forest trees, with ochraceous yellow bark and very hard, heavy, whitish timber; *Sophora* (?) *zambesiaca*, a large tree with white flowers; and *Piptadenia Buchanani*, which also occurs in Nyasaland, and reaches a height of 140 feet. *Erythrina Humeana* is a large tree up to 80 feet in height, and is somewhat thorny, with smooth pale grey-green bark. Among the Combretaceæ are species of *Combretum* and *Terminalia*, and *Pteliopsis myrtifolia*; the last-named is a large tree of the open woods,

with very dark rough bark, and is much sought after for maize stamping sticks owing to its toughness. Among the Myrtaceæ is *Syzygium cordifolium*, the water-boom of the Dutch, a large tree with shady evergeen foliage. *Adina microcephala* is a tall Rubiaceous tree growing solely on the banks of rivers ; *Chrysophyllum fulvum*, reaching a height of at least 120 feet, is the chief Sapotaceous member of this tree-flora. *Maba mualala* (Ebenaceæ), *Strychnos Burtoni* and *S. mitis*—the latter one of the largest trees in the Melsetter district,—as well as *Acanthocleista zambesiaca* (Loganiaceæ), are worthy of mention here ; also *Croton sylvaticus* (reaching 100 feet), *Bosqueia Phoberos* (Urticaceæ), and a new *Celtis* (*C. dioica*). From Mr. Swynnerton's notes, entered under the species to which they respectively refer, it will be seen that a fair proportion of the flora consists of economic plants, such as textiles, reputed remedies, rubber, etc. The chief rubber-plants of the district are *Landolphia florida*, *L. Kirkii*, and the new *L. Swynnertonii*. *Excœcaria sylvestris* is also mentioned as yielding a milky latex apparently containing rubber. Gutta-percha is probably present in the latex of *Mimusops sylvestris* and species of *Chrysophyllum*. *Bosqueia Phoberos* is another laticiferous tree. The Céara rubber (*Manihot Glaziovii*) is cultivated.

We gratefully acknowledge help rendered by various friends, especially members of the Kew staff. Lt.-Col. Prain, Mr. N. E. Brown, and Mr. J. Hutchinson have given much assistance with the order Euphorbiaceæ, Mr. T. A. Sprague has worked out the Loranthaceæ, and Mr. A. W. Hill the genus *Thesium*. To Dr. Stapf we are indebted for valuable suggestions as to some of the grasses and for permission to publish his MS. name for a new species of *Pœcilostachys*, and to Mr. R. A. Rolfe for similar suggestions on some of the Orchids. Mr. J. R. Drummond has helped with the genera *Nymphœa* and *Grewia* ; Mr. S. T. Dunn has described a new species of *Millettia*, and Mr. W. P. Hiern a new *Diospyros*. Lastly, Mr. Swynnerton himself gave some assistance in certain genera of Polypetalous Dicotyledons, and has described several new species, also a new *Gardenia*.

The collection has been presented by Mr. Swynnerton to the British Museum, in the Herbarium of which the types and other specimens will be found. Representative sets have also been distributed to the Herbaria of the Royal Gardens, Kew, and the Royal Botanic Garden, Berlin.

DICOTYLEDONS.

POLYPETALÆ.

By Edmund G. Baker, F.L.S.

RANUNCULACEÆ.

The collection includes the following well-known plants:—*Clematis Wightiana*, Wall., Chirinda; *C. simensis*, Fres., Chirinda; *C. Stanleyi*, Hook., near Chirinda; *C. Kirkii*, Oliver, near Chirinda; *Thalictrum rhynchocarpum*, Dill. & Rich., Chipete.

Anemone peneensis, *E. G. Baker*, sp. nov.

Rhizoma crassum pilis fulvis tecto radices sat robustas et rigidas copiose emittens; foliis radicalibus in specimine nostro simpliciter ternatis, petiolo basi vaginante patentim villoso, foliolis junioribus papyraceis lateralibus oblique obovatis basi cuneatis margine antice dentato-serratis leviter lobatis ciliatis petiolulis brevibus superne glabris subtus ad venas sparse villosis, foliolis intermediis suborbiculari-ovatis basi late cuneatis nervis e basi 5–6 palmatim radiantibus petiolulis quam iis foliolorum lateralium multoties longioribus; scapo erecto terete villoso basi sericeo-villoso; bracteis acute trilobatis villosis vel subintegris; inflorescentia umbelliformi; alabastris globosis extus villosis; pedicellis villosis; sepalis petaloideis (sec. cl. detectorem) albis vel pallide purpureis ambitu valde variantibus oblongo-obovatis vel anguste oblongis basi non unguiculatis venosis apice sæpissime obtusis; staminibus numerosis filamentis exterioribus brevissimis interioribus longioribus, antheris brevibus quam filamentis interioribus multoties brevioribus, connectivo conspicuo; ovariis numerosis glabris, stylo gracili quam ovario circ. $2\frac{1}{2}$-plo longiore; toro basi glabro apicem versus hirto. Planta ob rhizoma crassum, folia simpliciter ternata foliolo intermedio petiolulo longiore suffulto, nec non inflorescentiam umbelliformem 3–5-floram memoratu digna.

Hab. Mt. Pene at 6500 ft.; n. 783; Sept.

A herb with handsome white flowers growing somewhat profusely among short grass on a steep rocky slope. Numbers of flowers were examined, and none had the green sepals of a *Knowltonia*, but always pure white or light purple.

Scapus 20–30 cm. altus. Petiolus 4–5 cm. Foliola 4–5 cm. longa, 2·5–3·0 lata. Foliolorum lateralium petiolulus 3–10 mm. Foliolorum

intermediorum petiolulus 1·5–2·5 cm. longus. Pedicelli 3·5–8·0 cm. longi. Sepala 1·0–1·8 cm. longa. Filamenta exteriora ± 1 mm., interiora ± 3·5 mm. longa. Antheræ 0·75–1 mm. longæ. Ovarium ± 1 mm. longum. Stylus ± 2·0 mm. longus. Torus ± 3 mm. altus.

Allied to *Knowltonia transvaalensis*, Szyszyl., from which it differs by the leaves being simply ternate and the leaflets being more or less lengthily petiolulate.

Closely allied plants were collected on the Chimanimani Mts. at 7000 ft., with simply ternate leaves, n. 788, in fl. Sept. 28, and on the hills near the Haroni River at 5500 ft., n. 787.

RANUNCULUS PLEBEIUS, *R. Br. ex DC. Syst.* i. 288.

Chirinda Forest, 3700–4000 ft.; in fl. April & Oct.; n. 345. A herb with yellow flowers, growing in damp ground in the forest.

Distrib. Australia and New Zealand, Cape Colony (Schneeberg), Basutoland.

ANONACEÆ.

UVARIA GAZENSIS, *Swynnerton, E. G. Baker*, sp. nov.

Frutex elatus, scandens, ramulis novellis ferrugineo-pubescentibus, ramis cortice brunneo tectis; foliis ellipticis tenuiter coriaceis, lamina supra præter costam glabrescente subtus omnino glabrescente apice breviter acuminata vel acuta vel obtusa basi cuneata nervis lateralibus 11–15 arcuatim adscendentibus supra prominulis, nervis secundariis tenuibus vix conspicuis, petiolo brevi breviter pubescente supra canaliculato; floribus solitariis vel binis pedunculatis bracteolatis, bracteola semiamplectente; sepalis extus ferrugineo-pubescentibus suborbicularibus apice subobtusis; petalis exterioribus oblongo-ovatis viridibus crassis interioribus paullo angustioribus quam sepalis fere duplo longioribus; staminibus numerosis apice dilatatis, connectivo in apicem ovoideum producto; carpellis lineari-oblongis extus pubescentibus, stylo truncato, ovulis numerosis biserialibus stigmate leviter dilatato glabro.

Hab. Chirinda outskirts, 3700–4000 ft.; in fl. Oct.; n. 1326. A large shrub with woody trailing branches, green thick fleshy petals, dull pink stamens, and pale Naples-yellow stigmas.

Frutex usque ad 8 m. attingens. Folia 6·0–11·0 cm. longa, 3·0–4·0 cm. lata; foliorum petiolus 3–4 mm. longus. Pedunculus sæpe 1 cm. longus. Sepala 8 mm. longa et lata. Petala exteriora 14 mm. longa, 7·5 mm. lata, interiora 14 mm. longa, 6 mm. lata. Stamina 3 mm. longa. Carpella 5 mm. longa.

Allied to *U. nyassensis*, Engler & Diels. Differs by the non-pilose branchlets and longer pedicels.

The following clavis shows the position of this plant with its nearest allies :—

A. Flowers subsessile.
  * Petals 11 mm. long. Sepals 6·5 mm. long.
    U. virens, N. E. Br. Delagoa Bay.
  ** Petals 10–15 mm. long. Sepals 10 mm. long.
    U. angolensis, Welw. Angola.

B. Flowers distinctly pedicellate.
  * Petals 10–12 mm. long. Sepals 6 mm. long.
    U. Chamæ, Beauv., var. *macrocarpa*, Engler & Diels. Guinea, Cameroons, Senegambia.
  ** Petals 10 mm. long. Sepals 8 mm. long.
    U. nyassensis, Engler & Diels. Nyasaland.
  *** Petals 14 mm. long. Sepals 8 mm. long.
    U. gazensis, Swynnerton. Gazaland.

Mr. Sim (Forest Flora of Port. East Africa, p. 8) records *U. caffra*, E. Mey., as occurring in the forests at Arenga, Bajon, and Nhamecurre, and *U. acuminata*, Oliver, from the Rovuma River.

ANONA SENEGALENSIS, *Pers. Syn.* ii. 95.

Near Chirinda, 3500 ft. ; n. 191. Amanzimhlope, Lower Buzi, 100 ft. ; in fr. Dec. ; n. 1331. Chibabava, Lower Buzi, 400 ft. ; in fl. Dec. ; n. 1332. Chindao, "Muyembe" ; Singuni, "Umpovana" or "Impovana."

Var. CUNEATA, *Oliver, Fl. Trop. Afr.* i. 16.

Madanda Forest at about 400 ft. ; n. 1330. Chibabava, 400 ft. ; n. 1333. This is a form with shorter leaves than *Welwitsch*, n. 745, the type of this variety.

Distrib. (type) Widely spread ; (variety) Angola, Kunene Region.

POPOWIA OBOVATA, *Engler & Diels in Engler Monogr. Afr. Pfl.* vi. 44.

Inyamakinga River, Chikore, 3000 ft. ; in fl. Apr. ; n. 187. Muchukwana, Lower Buzi, 400 ft. ; n. 1329. A large shrub with slender trailing twigs common at Boka, at Chibabava, and elsewhere along the Lower Buzi River.

Distrib. Great Lake Region, Nyasaland, Zambesi, Kunene.

P. FERRUGINEA, *Engler & Diels, l. c.* 46.

Madanda Forest at about 400 ft., in fl. Dec. ; n. 1327. A woody trailing shrub, switches from which were used in the time of the chief Gungunyana to punish refractory girls. Hence the Singuni name "Mutoshay' intombi" (girl beater).

Distrib. Lake Region, Usambara, Nyasaland, Angola.

ARTABOTRYS BRACHYPETALUS, *Benth. in Trans. Linn. Soc.* xxiii. (1862) 467.

Madanda Forest at about 400 ft. ; n. 1231. A large climbing shrub ; flowers just over and fruit.

Distrib. Zambesi to Natal.

A. MONTEIROÆ, *Oliver in Hook. Ic. Plant.* i. t. 1796.

Chimanimani Mts. at 7000 ft., undeveloped fls. Sept. ; n. 1764. Madanda Forest at about 400 ft. ; in fl. Dec. ; n. 1183. A woody climbing shrub with pale green flowers.

Distrib. Natal, Zululand, Delagoa Bay.

MONODORA JUNODI, *Engler & Diels, Notizbl. K. Bot. Garten*, ii. (1899) 301.

Madanda Forest at about 400 ft. ; in fl. Dec. ; n. 1765. A small tree not uncommon in the rubber-forests about Butiro. A form with petals not so cordate as the type. Chindao name, "Musikosiko."

Distrib. Delagoa Bay, Lourenço Marques.

MENISPERMACEÆ.

CISSAMPELOS TORULOSA, *E. Meyer, ex Harv. & Sond. Fl. Cap.* i. 11.

Chipete Forest Patch, 3800 ft. ; in fl. Jan. ; nos. 218 & 219.

Distrib. Mozambique District, Natal & Cape.

C. PAREIRA, *Linn.*, var. MUCRONATA, *Dur. & Schinz, Consp.* i. 51. (*C. mucronata*, Rich.)

Chipete Forest Patch, 3800 ft. ; in fl. Jan. ; n. 220. Kurumadzi, 2000 ft. ; in fr. Dec. Boka, 100 ft. Idunda River, 100 ft. Chibabava.

Distrib. Widely distributed.

COCCULUS VILLOSUS, *DC. Syst. Veg.* i. 525.

Sabi River at 1000 ft. ; in fr. Nov. ; n. 1756 A.

Distrib. Widely distributed.

TILIACORA FUNIFERA, *Oliver, Fl. Trop. Afr.* i. 44.

Mt. Maruma, 3500 ft. ; in fl. Sept. ; n. 1347. Madanda Forest, 400 ft. ; in fr. Dec. ; n. 1232.

Distrib. Rhodesia, Zambesia.

DIOSCOREOPHYLLUM CHIRINDENSE, *Swynnerton*, sp. nov.

D. radice tuberosa ± fusiformi intus cava ; caule volubili tenui parce piloso ; foliorum petiolo tenui quam lamina aut longiore aut breviore, lamina papyracea, subtus pallidiore alte trilobata vel subquinquelobata latiore quam longa e basi palmatim 5–7-nervi, lobis apice acuminatis, margine subintegra utrinque præcipue vero subtus ad nervos sparsim pilosa ; pedunculo tenui

racemum subæquante sparsim piloso; bracteis oblanceolatis dorso et ad apicem pilis longis sparsim instructis quam pedicellis glabris subduplo brevioribus; alabastris globosis; floribus ♂ in vivo læte flavis in sicco atro-brunneis; sepalis 6 biseriatis ovatis vel interdum obovatis glabris nisi subtus ad costam pilis sparse indutis subæqualibus sub anthesi reflexis; petalis 0; staminibus 6 in synandrium brevissime stipitatum hemisphæricum connatis, antheris thecis parallelis extrorsum dehiscentibus; floribus femineis ignotis.

Hab. Chirinda Forest, 3700–4000 ft.; in flower Jan. & March; nos. 100 & 100 *a*. A herbaceous climber with bright yellow flowers and hollow tuberous root; somewhat scarce; in fr. Dec.; n. 6521.

Caulis ad 4 m. attingens, internodiis elongatis 14–22 cm. longis. Foliorum petiolus 6·5–13 cm.; folia 7–11·5 cm. longa, 8·5–15 cm. lata; pedunculus 5–8·5 cm. longus; pedicellus 3–5·5 mm. longus, glaber. Racemi 3·5–5 cm. longi. Flores ♂: sepala 2·5–4 mm. longa, ± 1·5 lata. Synandrium ± 1–1·5 mm. altum, 2–2·5 mm. diam.

Dr. Diels in his recent Monograph of Menispermaceæ places this plant under *D. Volkensii*, Engler, but it differs from this species in the following characters:—

The leaves are deeply lobed.
The sepals of the ♀ fl. are longer and narrower.
The pedicels are at first hairy.
The fruiting pedicels are shorter than those of the true *D. Volkensii*.

ANISOCYCLA BLEPHAROSEPALA, *Diels, Menisp. in Engl. Pflanzenr.* 93 (1910).
Madanda Forest; in fl. Dec.; n. 1346.

NYMPHÆACEÆ.

(J. R. DRUMMOND, F.L.S.)

NYMPHÆA sp.
Inyamadzi Valley, 2500 ft.; in fl. Sept.; n. 720. A water-lily common in this river with light blue flowers. Perhaps a form of *N. capensis*, Thunb., but differing in the lanceolate and spotted sepals.

CAPPARIDEÆ.

The collection includes the following well-known plants:—*Cleome monophylla*, Linn., Lower Buzi River; *Polanisia viscosa*, DC., Beira beach; *Gynandropsis pentaphylla*, Linn., Chimanimani Mts. and Chibabava; and *Mærua nervosa*, Oliver, from the Sabi River.

Capparis rosea, *Oliver, Fl. Trop. Afr.* i. 99. (*Petersia rosea*, Klotzsch.)
Madanda Forest at 400 ft. ; in fr. Dec. ; n. 2164.
Distrib. Mozambique District.

C. Kirkii, *Oliver, l. c.* i. 98.
Madanda Forest at 400 ft.; n. 1742.
Distrib. Mozambique District. No flowers or fruit found.

Thylachium verrucosum, *Klotzsch in Peters Mossamb. Bot.* 162.
Sabi River at 1000 ft. ; in fr. Nov. ; n. 1206.
Distrib. Mozambique District.

Courbonia decumbens, *Brongn. in Bull. Soc. Bot. Fr.* vii. (1860) 901.
Sabi River at about 1000 ft. ; in fr. Nov. ; nos. 1207 & 1384. A small shrub ; fruits red when ripe. Chindao, "Tukwinge."
Distrib. Nile Land, Mozambique District.

VIOLACEÆ.

Viola abyssinica, *Hochst. ex Oliver, Fl. Trop. Afr.* i. 105.
Mt. Pene, 7000 ft. ; in fl. Oct. ; n. 6203.
Distrib. Widely distributed on the mountains of Tropical Africa. Occurs also in the Transvaal and Mauritius.

Ionidium enneaspermum, *Vent. Jard. Malm.* sub 27.
Beira open woods, 50 ft. ; in fl. Dec. ; n. 1762.
Var. hirtum, *Oliver, Fl. Trop. Afr.* i. 106. (*I. hirtum*, Klotzsch in Peters Mossamb. Bot. 148.)
Madanda Forest at about 400 ft.; in fr. Dec. ; n. 2041.
Distrib. (type) Widely distributed ; (var. *hirtum*) Zambesi.

Alsodeia ilicifolia, *Welw. in Trans. Linn. Soc.* xxvii. (1869) 12.
Lower Zona, Jihu, 2400 ft. ; n. 179.
Distrib. Angola, Sierra Leone, Mozambique District, Uganda, British East Africa.
Mr. Sim (Forest Flora Port. E. Afr. 11) has two species of this genus, *Rinorea elliptica* from Rovuma River, and *R. ardisiæflora* from the Lebombo Mts. and also from Natal, Pondoland, and Angola.

Alsodeia (Petalandra) convallarioides, *E. G. Baker*, sp. nov.
Frutex cortice lævi instructus, ramulis tenuibus ; foliorum petiolo brevi canaliculato, lamina subcoriacea viridi ovata vel oblongo-ovata vel oblongo-elliptica utrinque obtusa margine leviter serrata nervis lateralibus utrinque 4–5 adscendentibus tenuibus cum venis reticulatis subtus prominentibus; inflorescentiis racemosis præter petala pube brevi indutis longitudine et

numero florum valde variis; bracteis ad basin pedicellorum sitis ovatis pedicellis nunc flore brevioribus nunc longioribus, quam iis *A. natalensis*, E. G. Baker, brevioribus; sepalis ovatis margine ciliatis; petalis oblongis (sec. cl. detectorem) viridi-albis quam sepalis 4–5-plo longioribus; staminum connectivo ultra thecas in laminam petaloideam persistentem dilatato, filamentis liberis; ovario ovoideo superne in stylum circ. 5-plo longiorem et filiformem contracto; capsula coriacea glabra ovoidea extus reticulata.

Chirinda Forest; in fl. Sept., n. 2119; in fr. Oct., n. 2119 *a*.

A large shrub with smooth bark and greenish-white flowers, not uncommon in Chirinda. Superficially these remind one of clusters of *Convallaria*.

Folia 2·0–7·2 cm. longa, 13–35 mm. lata. Foliorum petiolus 2–3 mm. longus. Racemi 15–20 mm. longi. Bracteæ ad basin pedicellorum circ. 1·5 mm. longi. Pedicelli 4–5 mm. longi. Sepala circ. 1·5 mm. longa. Petala circ. 5–6·5 mm. longa. Capsula 13–14 mm. longa, 10–11 mm. lata.

Allied to *A. natalensis* (Engler), E. G. Baker, nov. comb., and *A. elliptica*, Oliver.

* Petala circ. 5–6·5 mm. longa.
† Pedicelli circ. 1 cm. longi.
A. natalensis (Engler), E. G. Baker. Natal, Pondoland.
†† Pedicelli circ. 4–5 mm. longi.
A. convallarioides, E. G. Baker. Gazaland.
** Petala angustiora et longiora circ. 9 mm. longa.
A. elliptica, Oliver. Rovuma River.

The noticeable features of this shrub are the racemes of greenish-white flowers resembling a *Convallaria* and the free filaments of the stamens. The pedicels are pubescent, subtended at the base by bracts. N. 1110 from Chirinda Forest is probably also this species, but it is only in fruit.

ALSODEIA (Petalandra) GAZENSIS, *E. G. Baker*, sp. nov.

Frutex ramulis novellis fusco-tomentellis; foliorum petiolo mediocri, lamina chartacea oblongo-obovata apice subacuminata basi rotundata vel cuneata margine dentata costa superne impressa nervis lateralibus utrinque 11–13 prope marginem adscendentibus et connexis nervis secundariis inter primarios transversis; inflorescentia paniculata, pedunculis pedicellisque fusco-tomentellis, bracteis lanceolatis acutis; sepalis imbricatis ovatis extus fusco-pubescentibus; petalis (sec. cl. detectorem) flavis ovato-lanceolatis dorso medio puberulis basin versus angustatis et margine ciliatis quam sepalis distincte longioribus; tubo stamineo margine libero inter antheras leviter lobato; antheris filamento brevi insidentibus, connectivo ultra thecas in laminam petaloideam persistentem dilatato; ovario superne in stylo attenuato.

Hab. Chirinda Forest, 3700–4000 ft.; in fl. Oct., n. 132; in fr. Dec., n. 6500.

A common shrub, 8, 10 or sometimes 15 ft. high. Flowers yellow. Probably also n. 531 from Mt. Maruma, but the specimen is not in flower.

Foliorum lamina 13–17 cm. longa, 5·0–6·5 cm. lata ; petioli 1·5–2·0 cm. longi. Sepala ± 4·5 cm. longa. Petala ± 6 mm. longa. Tubus stamineus ± 1·5 mm. altus. Lamina petaloidea ultra thecas fere 2 mm. dilatata.

Allied to *Alsodeia castaneoides*, Welw. ; differs by the longer petioles and by the longer petaloid lamina of the anthers.

BIXINEÆ.

ONCOBA SPINOSA, *Forsk. Fl. Ægypt.-Arab.* 103.

Kurumadzi River, Jihu, 2000 ft. ; in fl. Nov. ; n. 1337. Boka, Lower Buzi, 100 ft., in fl. Dec. ; n. 2043.

Distrib. Upper Guinea, Nile Land, Mozambique District.

APHLOIA THEÆFORMIS, *Benn. Pl. Jav. rar.* 192 in adnot.

Chimanimani Mts., 7000 ft. ; in fl. Sept. ; n. 634. Mt. Pene wooded glens, 6000–6500 ft. ; in fl. Sept. ; in fr. Oct. ; nn. 634 *a* & 6168. A fairly large tree.

Distrib. Nyasaland, also Madagascar, Mauritius, &c.

RAWSONIA LUCIDA, *Harvey & Sond. Fl. Cap.* i. 67.

Chirinda Forest, 3800 ft. ; in fl. Oct. ; n. 658. A fair-sized shrub with whitish flowers.

Distrib. Natal.

FLACOURTIA RAMONTCHI, *L'Hérit. Stirp. Nov.* 59, t. 30 & 30 bis.

Beira beach, sea-level ; in fr. Dec. ; n. 2044. A specimen from Madanda Forest, n. 1041, is very closely allied to, if not identical with, the Indian *F. sapida*, Roxb., which is placed in the Fl. Brit. Ind. i. 193 as subordinate to *F. Ramontchi*, L'Hérit.

Distrib. Widely distributed in Africa ; also Madagascar, India, &c.

F. HIRTIUSCULA, *Oliver, Fl. Trop. Afr.* i. 121.

Chibabava, Lower Buzi, 400 ft. ; in fl. Dec. ; n. 1410. Boka, Lower Buzi, 400 ft. ; in fl. Dec. ; n. 2045.

Distrib. Mozambique District.

N. 556 from Madanda Forest is probably also a species of *Flacourtia*, but it is only in fruit. It resembles *F. edulis*, Schum. & Thonn., var. *oblonga*.

ABERIA MACROCALYX, *Oliver, Fl. Trop. Afr.* i. 122.

Chirinda Forest, 3800–4000 ft. ; in fr. Oct. ; n. 68. An evergreen thorny diœcious shrub with edible fruit. Singuni name, "Umgogolo." Natal name, "Manyibi." The following, of which there are only male flowers, is closely

allied :—Mt. Maruma, 3500 ft. ; n. 1126. A large shrub with creamy-white flowers and yellow anthers.

Distrib. Angola.

KIGGELARIA AFRICANA, *Linn. Sp. Pl.* 1037.

Chimanimani Mts., 7000 ft.; n. 2039. Mt. Pene Forest, 6500–7000 ft. ; in bud Sept. ; n. 2040.

Distrib. South Africa, Natal, Rhodesia.

PITTOSPOREÆ.

PITTOSPORUM VIRIDIFLORUM, *Sims, Bot. Mag.* t. 1684.

Mt. Pene Forest, 6500–7000 ft.; in fr. Sept.; n. 671.

Distrib. South Africa, Angola. A fairly large tree.

POLYGALACEÆ.

POLYGALA VIRGATA, *Thunb. Prod. Fl. Cap.* 120.

Grass near Chirinda; in fl. Dec. ; n. 284. Melsetter, 6000 ft.; in fl. Oct. ; n. 6158. Chimanimani Mts., 7000 ft. ; in fl. Sept.; n. 2042.

Distrib. South Africa, Natal, Namaqualand, Rhodesia, Nyasaland.

P. ARENARIA, *Willd. Sp. Pl.* iii. 880.

Near Chirinda, 3800 ft. ; in fl. May; n. 282.

Distrib. Widely distributed.

P. HOTTENTOTTA, *Presl, Bot. Bemerk.* 15.

Mt. Pene, 7000 ft.; in fl. Dec.; n. 6154. Melsetter at 6000 ft.; in fl. Oct. ; n. 6157.

Distrib. Natal, Transvaal, Cape Colony.

P. abyssinica, Fres., from Abyssinia is very closely allied to the above.

POLYGALA GAZENSIS, *E. G. Baker*, sp. nov.

Suffrutex caulibus teretibus virgatis cano-pubescentibus mediocriter vel subdense foliosis; foliis alternatis lineari-oblongis sessilibus supra viridibus subtus canescentibus marginibus revolutis subcoriaceis costa superne impressa subtus conspicua nervis lateralibus non conspicuis; racemis lateralibus paucifloris et patulis, pedunculis bracteatis, bracteis triangulari-lanceolatis pedicello brevioribus, pedicellis quam sepalis exterioribus longioribus ; floribus (sec. cl. detectorem) pallide purpureis ; sepalis exterioribus ovato-oblongis vel ovato-ellipticis margine membranaceis ; alis multo majoribus unguiculatis subito in limbum leviter inæquilateralem subtriangularem dilatatis nervis numerosis a basi palmatim radiantibus ; carinæ limbo galeato ejus crista multifida penicellata carinam paullo superante; petalis superioribus quam

carina $\frac{1}{2}$ brevioribus profunde sed inæquilateraliter bifidis; ovario obovato glabro, stylo in medio torto apice glochidiato. Capsula ignota.

Hab. Chimanimani Mts. at 7000 ft.; n. 632; in fl. Sept. 26th, 1906. A tall slender shrub in forests of Chimanimani. Flowers light purple.

Caules saltem 15–30 cm. longi. Folia 1·5 ad fere 3 cm. longa, 4–5 mm. lata. Sepala exteriora ± 4 mm. longa. Alæ ± 11 mm. longæ. Petala superiora ± 8 mm. longa.

Allied to *P. peduncularis*, Burch., but differing by the terete stems and the upper petals not having a small tooth in the emarginate portion.

Securidaca longepedunculata, *Fres. in Mus. Senckenb.* ii. (1837) 275.
Lower Umswirizwi, 1000 ft.; in fl. Nov.; n. 2103.

Var. parvifolia, *Oliver, Fl. Trop. Afr.* i. 134.
Madanda Forest at about 400 ft.; nos. 1032 & 1741. Chikore Hills, 3500 ft.; n. 2038. Umvumvumvu River, 4000 ft.; n. 6155. S. Umtali District, 2000–3000 ft.; n. 6613. A fairly large tree with carmine flowers and fibrous bark used for cord. Judging from the figure and description, this is the plant described by Mr. Sim as *S. spinosa* in his 'Forest Flora of Portuguese East Africa.'

Distrib. (type) Widely distributed; (var. *parvifolia*) Delagoa Bay, Rhodesia, Amboland, Transvaal.

CARYOPHYLLACEÆ.

Silene Burchellii, *Otth in DC. Prod.* i. 374.
Mt. Pene, 7000 ft.; in fl. Oct.; n. 6069.
Distrib. Cape to Abyssinia.

Drymaria cordata, *Willd. ex Rœm. & Schultz, Syst.* v. 406.
Mt. Maruma, 3500 ft.; in fl. Sept.; n. 2046.
Distrib. Widely distributed in the Tropics.

Polycarpæa corymbosa, *Lam. Illustr.* ii. 129.
Chimanimani Mts., 7000 ft.; in fl. Sept.; n. 1804.
Distrib. Widely distributed in the Tropics.

PORTULACACEÆ.

Talinum cuneifolium, *Willd. Sp. Pl.* ii. 864.
Lower Buzi, 400 ft.; in fr. Dec.; n. 2047.
Distrib. Widely distributed in the Tropics.

Portulaca foliosa, *Ker-Gawl. in Bot. Reg.* t. 793.
Chibabava, Lower Buzi, 400 ft.; in fl. Dec.; n. 1746.
Distrib. Widely distributed in Tropical Africa.

HYPERICINEÆ.

HYPERICUM LANCEOLATUM, *Lam. Encycl.* iv. 145.

Near Melsetter, 6000 ft.; in fl. Sept.; nos. 681 & 681 *a*. Mt. Pene, 7000 ft.; in fl. Oct.; n. 6091. A shrub 6–8 ft. high with handsome yellow flowers.

Distrib. Upper Guinea, Nile Land, Mozambique District, Transvaal.

H. LALANDI, *Choisy in DC. Prod.* i. 550.

Lower Umswirizi, 1000 ft.; in fr. Nov.; n. 1748. Mt. Pene, 6000 ft.; in fl. Oct.; n. 6173.

Distrib. South Africa, Lower Guinea, Mozambique District.

H. ÆTHIOPICUM, *Thunb. Prod. Fl. Cap.* 138.

Chirinda, 3800 ft.; in fl. April, n. 374; and in fl. May, n. 508. A herb with bright yellow starry flowers, low growing, often appearing as a weed in cultivated ground. A form with rather numerous short wiry stems.

Distrib. South Africa. Also in the Kew Herbarium from Manika between Umtali and Inyanga Mts., collected by the Hon. Mrs. Evelyn Cecil.

PSOROSPERMUM FEBRIFUGUM, *Spach in Ann. Sc. Nat.* ser. 2, v. (1836) 163.

Near Chirinda, 3800 ft.; in fl. Oct.; n. 195. Chindao name, "Mutskwatsgwa." A small shrub common in the grass. A specimen from Beira in open woods is very closely allied to *P. ferrugineum*, Hook. fil., which was considered by Prof. Oliver as synonymous with the above.

Distrib. Widely distributed.

HARONGA MADAGASCARIENSIS, *Choisy, Prod. Mon. Hyper.* 34.

Kloof near Chirinda, 3800 ft.; in fl. & fr. Feb.; n. 161. A small tree common in the kloofs of the district, sap orange-yellow. Timber poor, liable to insect attack.

Distrib. Widely distributed in Tropical Africa. Also in Madagascar and Mauritius.

GUTTIFERÆ.

GARCINIA LIVINGSTONEI, *T. And. in Journ. Linn. Soc., Bot.* ix. (1870) 263.

Idunda River, Buzi, 100 ft.; in fr. Dec.; n. 1744. A small tree on limestone.

Distrib. Mozambique District.

N. 574 from the Chimanimani Mts. is also a species of *Garcinia*, but the flowers are only in bud.

DIPTEROCARPEÆ.

MONOTES HYPOLEUCUS, *Gilg in Engler Jahrb.* xxviii. (1899) 134.

Hills between Inyamadzi and Buzi, 3400 ft.; in fl. Dec.; n. 157. A shrub or small tree of the open woods. Hills near Upper Buzi, 3000 ft.; in fr. Oct.; n. 1314. Chindao name, "Chindhárara."

Distrib. Huilla.

MALVACEÆ.

The collection contains the following widely distributed species:—*Sida spinosa*, Linn., Zinzumbo Hill; *S. longipes*, E. Meyer, Kurumadzi; *S. cordifolia,* Linn., Chipetzana and near Chipinga and Madanda Forest; *Abutilon intermedium*, Hochst., Umvumvumvu River; *Hibiscus surattensis*, Linn., Chirinda; *H. cannabinus*, Linn., Chirinda and hills overlooking Lusitu River; *H. diversifolius,* Linn., Kurumadzi; *H. vitifolius*, Linn., Umhlonhlo and Madanda Forest.

ABUTILON ZANZIBARICUM, *Bojer, ex Mast. in Oliver, Fl. Trop. Afr.* i. 186.

Boka Inyamita, Lower Buzi, 100 ft.; in fl. & fr. Dec.; n. 2048. A large herb with yellow flowers, on limestone.

Distrib. Upper and Lower Guinea, Mozambique District.

A. SONNERATIANUM, *Sweet, Hort. Brit.* i. 54.

Near Chirinda, 3800 ft.; in fl. & fr. May; n. 504. A fairly large herb with deep Naples-yellow flowers. Occurs in grass and cultivated ground.

Distrib. South Africa.

PAVONIA SCHIMPERIANA, *Hochst. ex Rich. Fl. Abyss.* i. 52.

Chirinda outskirts, 3700–4000 ft.; in fl. May; n. 523. A tall herb with pink flowers.

Distrib. Upper and Lower Guinea, Nile Land, Mozambique District, Congo Region.

P. COLUMELLA, *Cav. Diss.* 138, t. 48. f. 3.

Near Chirinda, 3800 ft.; in fl. April; n. 299. Melsetter, Rhodesia, 6000 ft.; in fl.; n. 2049. Chirinda Forest outskirts, 3800 ft.; in fl. May; n. 525.

Distrib. South Africa, Mozambique District.

P. ODORATA, *Willd. Sp. Pl.* iii. 837.

Madanda Forest at about 400 ft.; in fl. Dec.; n. 2050. A shrublet with white flowers.

Distrib. Nile Land, Mozambique District.

HIBISCUS (Ketmia) SWYNNERTONII, *E. G. Baker*, sp. nov.

Caule herbaceo ± fusco vel cinereo-hirsuto et pilis longis et patentibus consperso; foliis longiuscule petiolatis, petiolo fusco- vel subcinereo-hirsuto, usque ad medium palmatim 5-lobatis discoloribus subtus dense cinereo-tomentosis lobis oblongis vel ellipticis margine crenatis vel crenato-serratis; floribus axillaribus, pedunculis striatis pilis longis et patentibus instructis apicem versus articulatis quam calyce 2–3-plo longioribus; involucri phyllis circ. 8 linearibus hirsutis calycis tubo subæquilongis; calycis tubo quam laciniis breviore extus fusco- vel rufo-tomentoso segmentis lanceolatis striatis; petalis (sec. cl. detectorem) albis; styli ramis apice in stigmata capitata dilatatis; capsula extus hirsuta apice apiculata quam calyce paullo breviori vel eum subæquante loculis circ. 6-spermis, seminibus angulato-subreniformibus glabris.

Hab. Sabi River at about 1000 ft. A herb with white flowers trailing along the ground near the water.

Folia 3·0–3·5 cm. longa, foliorum petioli 3·0–5·0 cm. longi. Pedunculi 3·5–4·5 cm. longi. Involucri phylla 5–7 mm. longa. Calycis tubus 5 mm. longus, laciniæ 9–13 mm. longæ. Petala 3·0–3·5 cm. longa.

This plant is certainly allied to *H. Schinzii*, Gürke, from Amboland, and *H. physaloides*, Guill. & Perr., but differs in the shape of the lobes of the leaf, which are much narrower at the base and not at all triangular; and Mr. Swynnerton says the flowers are white, while those of *H. Schinzii*, Gürke, are yellow with a purple base.

H. MICRANTHUS, *Linn. fil. Suppl.* 308.

Madanda Forest at about 400 ft.; in fl. & fr. Dec.; n. 2052. Chirinda, Lower Buzi, 200 ft. (forma); in fl. & fr. Dec.; n. 2051.

Distrib. Widely distributed in the Tropics.

H. SHIRENSIS, *Sprague & Hutchinson in Kew Bull.* 1907, 47.

Kurumadzi, River Jihu, 2000 ft. Chirinda outskirts, 3700–4000 ft.; n. 298. A very tall herb with bright red flowers.

Distrib. Nyasaland.

H. GOSSYPINUS, *Thunb. Prodr. Fl. Cap.* 118.

Wooded glen near Chirinda, 3500 ft.; in fl. July; n. 2053. A very tall herb. Petals glossy white; anthers orange-yellow.

Distrib. South Africa, Mozambique District, Nyasaland.

H. NATALITIUS, *Harvey in Harvey & Sond. Fl. Cap.* ii. 587.

Madanda Forest at about 400 ft.; in fl. Dec.; n. 2054. A herb.

Distrib. Natal.

H. ÆTHIOPICUS, *Linn. Mant.* ii. 253.

Northern Melsetter, 5000–6000 ft.; in fl. Oct.; n. 6222.

Distrib. South Africa, Mozambique District, Uganda.

STERCULIACEÆ.

STERCULIA TRIPHACA, *R. Br. in Benn. Pl. Jav. Rar.* 228.

Lower Umswirizwi, 1000 ft.; n. 58. A large tree with smooth, richly coloured bark.

Distrib. Nile Land, Mozambique District.

DOMBEYA RETICULATA, *K. Schum. in Engl. Mon.* 36, vix *Masters.*

Inyamadzi Valley, 2500 ft.; in fl. Sept.; n. 1318. A tree with rough bark, round leaves, pink young foliage, and very handsome masses of flowers. Chindao name, "Siyasetu." Near Chirinda; in fl. July; n. 47.

Distrib. Central African Lake Region, Mozambique District.

D. (Eudombeya) ROSEA, *E. G. Baker*, sp. nov.

Frutex elatus, ramis florentibus teretibus ± pilis patentibus tectis; stipulis ovatis acuminatis; foliis longiuscule petiolatis, petiolo tereti ± piloso, ovatis sæpissime alte trilobatis apice acuminatis basi alte cordatis palmatim septemnerviis margine sæpissime crenatis vel crenato-serratis utrinque tomentosis; inflorescentia coëtanea pedunculata sæpissime 2–7-flora; floribus graciliter pedicellatis, pedicellis subpilosis vel subtomentosis; bracteolis sub calyce ovatis acuminatis; sepalis lanceolatis cinereo-tomentosis quam petalis paullo brevioribus; petalis obovatis inæquilateris paullo longioribus quam latis (sec. cl. detectorem) pallide puniceis; staminibus mediis triadum brevissimis, staminodiis lineari-lanceolatis; stylo basi stellato-piloso, stigmatibus 5 recurvatis; ovario pentamero albo-hirto, capsula 5-loculari, seminibus 3–5 pro loculo.

Hab. Near Chirinda, 3900 ft.; n. 196; in fl. April, 1906.

A large shrub plentiful in many parts of the district in Jihu soil. Flowers pinkish white, reminding one much of the dog rose.

Frutex 2–4 m. altus. Petioli 7·0–14·0 cm. longi. Folia 10·0–16·0 cm. longa et lata. Bracteolæ sub calyce 1·5–1·8 cm. longæ. Sepala ± 15 mm. longa. Petala ± 1·6–2·0 cm. longa, sæpissime latiora quam longa. Antheræ 4·0–4·5 mm. longæ. Stylus ± 6 mm. longus. Stigmata ± 6 mm. longa.

Closely allied to *D. Burgessiæ*, Gerrard. Differs by the bracteoles being more acuminate at the apex and the narrower staminodia.

MELHANIA FORBESII, *Planchon in Oliver, Fl. Trop. Afr.* i. 231.

Lower Buzi, 0–400 ft.; in fl. Dec.; n. 2055.

Distrib. Mozambique District.

HERMANNIA KIRKII, *Masters in Oliver, Fl. Trop. Afr.* i. 233.

Madanda Forest at about 400 ft.; in fr. Dec.; n. 2059.

Distrib. Mozambique District, German East Africa.

WALTHERIA AMERICANA, *Linn. Sp. Pl.* 673 (1753).

Chimanimani Mts., 7000 ft.; in fl. Sept.; n. 2057. Madanda Forest, 400 ft.; in fl. Dec.; n. 2056. Chipetzana, 3000 ft.; in fl. April; n. 2058.

Distrib. Widely distributed.

TILIACEÆ.

GREWIA MADANDENSIS, *J. R. Drummond MS. in Herb. Mus. Brit.*, sp. nov.

Arbuscula, ramulis adultioribus teretibus glabris novellis cinereo-pubescentibus; foliis mediocriter petiolatis, lamina subcoriacea manifeste discolore supra glabra subtus cinereo-pubescente oblonga vel ovato-oblonga basi leviter obliqua rotundata vel leviter subcordata vel interdum cuneata apice acuta vel obtusa margine serrulata costa superne impressa basi trinervia nervis lateralibus utrinque 3–4 adscendentibus superne non prominulis; inflorescentia axillari pedunculis sæpissime quam pedicellis brevioribus 1–3-flora, alabastris oblongo-ellipticis extus cinereo-pubescentibus striatis; sepalis linearibus quam petalis paulo longioribus; petalis luteis oblongis ad ¾ longitudinem sepalorum attingentibus basi area glandulosa ad quartam partem petalorum adnata; toro inferne glabro; ovario cinereo-pubescente bilobo; fructu ignoto.

Hab. Madanda Forest at about 400 ft.; n. 1221; in fl. Dec. 6, 1906.

A small tree with yellow flowers, on the ant-heaps at Ancate. Singuni name, "Umsipana."

Folia adulta 3·0–4·0 cm. longa, 1·2–2·0 cm. lata; petioli 4·0–6·0 mm. longi. Sepala ± 1·0 cm. longa. Petala cum area glandulosa ± 8·0 mm. longa. Area glandulosa circ. 2·0 mm.

This species is allied to *G. grisea*, N. E. Br. (Ngamiland, *C. J. Lugard*, n. 54).

Dr. Burret in his recent Monograph of the African species places *G. grisea*, N. E. Br., among his "species dubiæ vel non visæ."

GREWIA SWYNNERTONII, *J. R. Drummond MS. in Herb. Mus. Brit.*, sp. nov.

Frutex prostratus ramulis adultis teretibus glabrescentibus florigeris pubescentibus; foliis in speciminibus nostris parvis inter minores generis breviuscule petiolatis, petiolo albo-hirto, lamina ovato-lanceolata vel oblongo-lanceolata basi subcordata obliqua apice obtusa vel subacuta margine serrata vel crenato-serrata utrinque stellato-pubescente stipulis setaceis caducis; inflorescentia axillari; pedunculis pedicellisque albo-hirtis, alabastris oblongo-ellipticis striatis; sepalis linearibus extus stellato-tomentosis; petalis oblongis vel ovato-oblongis in sicco luteis quam calyce triente brevioribus area glandulosa ad tertiam partem adnata; staminibus calyce paulo brevioribus;

toro inferne glabro superne tomentoso ; ovario pilis albidis tecto biloculari.

Hab. Lower Umswirizwi River, 1000 ft. ; n. 201. A trailing shrub with yellow flowers.

Folia 1·5–2·2 cm. longa, 1·0–1·2 cm. lata. Petioli 1·0–2·0 mm. longi. Sepala ± 6 mm. longa. Petala cum area glandulosa ± 4 mm. longa. Stylus ± 4 mm. longus.

Allied to *G. rotundifolia*, Juss. ; differs in the shape of the leaves. A specimen from Madanda Forest, alt. 400 ft., n. 1218, is probably the above. The fruit is dry and bilobed. This agrees with the specimen from Shigogo collected by Sir John Kirk, which was referred by Dr. Masters in the 'Flora of Tropical Africa,' i. 251, to *G. parvifolia*, Hochst.

GREWIA FRUTICETORUM, *J. R. Drummond MS. in Herb. Mus. Brit.*, sp. nov.

Frutex ramulis adultioribus glabris teretibus lenticellosis novellis pubescentibus ; foliis chartaceis breviuscule petiolatis ellipticis vel ovato-ellipticis basi rotundatis apice obtusis mucronatis margine serrulatis superne glabris subtus præcipue in costa nervisque sparsissime stellato-pubescentibus e basi trinerviis nervis lateralibus utrinque 6–7 secundariis tenuissimis; stipulis setaceis ; inflorescentia axillari, pedunculis pedicellis subæquilongis sæpe 2–3-floris ; alabastris subcylindricis extus cano-pubescentibus ; sepalis linearibus quam petalis longioribus ; petalis (sec. cl. detectorem) luteis lineari-lanceolatis acuminatis ad basin area glandulosa ad quartam vel quintam partem adnata ; toro inferne glabro superne pubescente ; ovario extus pubescente 4-loculari, fructu ei *G. polypyrænæ*, Baker subsimili.

Hab. Chibabava, Lower Buzi, 400 ft. ; n. 1222. In fl. Nov. 28th, 1906. A shrub forming dense thickets. Flowers yellow.

Folia 2·5–4·5 cm. longa, 1·8–2·1 cm. lata, petioli 3–4 mm. longi. Sepala 10–11 mm. longa. Petala cum area glandulosa circ. 9 mm. longa. Area glandulosa ± 2 mm.

Allied to *G. caffra*, Meisn. ; differs by the leaves being slightly broader and the pubescent portion of the torus shorter.

This shrub is closely allied to a specimen from Sabaki Melinde, collected by Sir John Kirk.

GREWIA CHIRINDÆ, *E. G. Baker*, sp. nov.

Frutex (sec. cl. detectorem) prostratus ramulis adultioribus glabris novellis fusco- vel rufo-pubescentibus ; foliis mediocriter petiolatis ovatis vel ovato-lanceolatis margine crenato-serratis basi rotundatis vel leviter subcordatis et e basi trinerviis apicem versus sæpissime attenuatis apice ipso obtusis superne glabris subtus præcipue ad costam stellato-pubescentibus, nervis lateralibus utrinque 5–6 subtus prominulis ; stipulis subulatis ; inflorescentia axillari, pedunculis paucifloris sæpe bifloris, pedicellis pubescentibus striatis crassi-

usculis ; sepalis linearibus vel lineari-lanceolatis extus breviter cinereo- vel fusco-tomentosis apice acutis quam petalis aliquanto longioribus ; petalis (sec. cl. dectectorem) roseis lineari-lanceolatis vel lineari-oblongis apice sub-acuminatis ad basin area papillosa præcipue superne villosula ; toro elongato basi angulato et glabro superne pubescente ; ovario pubescente 2–3-loculari loculis pluriovulatis ; stylo erecto glabro quam ovario 4–5-plo longiore ; drupa triloba.

Hab. Chirinda outskirts, 3700–4000 ft. ; n. 131. In fl. Nov. 1904. A trailing shrub with pink flowers.

Folia 4·5–5·5 cm. longa, 3·3–4·0 cm. lata; petioli 8–11 mm. longi. Pedunculi 10–13 mm. longi. Pedicelli 10–11 mm. longi. Sepala ± 18 mm. longa. Petala cum area glandulosa 13 mm. longa. Area glandulosa ± 2 mm. longa Stylus erectus ± 7 mm. altus.

Allied to *G. occidentalis*, Linn., but the sepals and petals are longer and broader.

GREWIA OCCIDENTALIS, *Linn. Sp. Pl.* 964.

Chirinda outskirts, 3800 ft. ; in fl. Dec. ; n. 6628.

Distrib. South Africa, Transvaal, Delagoa Bay.

G. INÆQUILATERA, *Garcke in Peters Mossamb. Bot.* 134.

Chibabava, Lower Buzi, 400 ft. ; in fl. Dec. ; n. 1223. A small tree 25 ft. high with a 40 ft. spread of branch. Drooping twigs. Flower yellow. Chindao name, "Chisosoti."

Distrib. Mozambique District.

G. OBOVATA, *K. Schum. ex Engler in Abh. Preuss. Akad. Wiss.* (1894) 18.

Sabi River at about 1000 ft. ; in fr. Nov. ; n. 1217. A woody trailer. Chindao name, "Umtetenevigwa-wesabi."

Distrib. Zanzibar Coast Region.

Dr. Burret considers *G. obovata*, K. Schum., a variety of *G. sulcata*, Masters.

TRIUMFETTA ANNUA, *Linn. Mant.* 73.

Near Chirinda, 3800 ft. ; in fl. & fr. April, n. 272 ; in fl. May, n. 473. A herb with yellow flowers.

Distrib. Widely distributed in Tropical Africa, also Natal, Madagascar, &c.

T. EFFUSA, *E. Meyer, ex Harv. in Harvey & Sond. Fl. Cap.* i. 228 (1860).

Near Chirinda, 3800 ft. ; in fr. April ; n. 1156.

Distrib. Rhodesia, Natal.

T. PILOSA, *Roth, Nov. Pl. Sp.* 223 (1821) ; *Sprague & Hutchinson in Journ. Linn. Soc., Bot.* xxxix. (1909) 274.

Near Chirinda, 3500 ft., n. 270 ; in fl. Feb., n. 271. These come near

var. *nyasana*, Sprague & Hutchinson, *l. c.* A tall herb often occurring as a weed in cultivated ground.

Distrib. India, Tropical Africa, Transvaal, Natal.

T. morumballana, De Wild. Pl. Nov. Hort. Thenen., is hardly distinguishable from the above.

TRIUMFETTA RHOMBOIDEA, *Jacq. Enum. Pl. Carib.* 22 (1760).

Near Chirinda, 3800 ft. ; in fl. Feb., n. 270 ; in fr. May, n. 472. Also 3700–4000 ft. ; in fl. April ; n. 1157. Upper Buzi, 3000 ft. ; in fr. April ; n. 2063. Kurumadzi River, Jihu ; in fl. Nov. ; n. 2064.

Distrib. Widely distributed.

T. MASTERSII, *Bak. fil. in Trans. Linn. Soc.* ser. 2, *Bot.* iv. (1894) 6.

Chipetzana River, 3000 ft. ; in bud Oct. ; n. 2061. Nyahodi River, 5000 ft. ; in bud Sept. ; n. 2060. A herb. Leaves required to confirm identification.

Distrib. Mozambique District.

T. DEKINDTIANA, *Engler in Engler Jahrb.* xxxix. (1907) 580.

Umvumvumvu River, 4000 ft. ; in fr. April ; n. 2062. A herb.

Distrib. Angola to Rhodesia and German East Africa.

SPARMANNIA PALMATA, *E. Meyer, ex Presl, Bot. Bemerk.* 19.

Chipete Forest Patch outskirts, 3800 ft. ; in fl. April ; n. 225. A climber with white flowers. Leaves less lobed than type.

Melsetter, 6000 ft. ; in fr. April ; n. 789. Differs from type in leaves being less deeply lobed and bristles on fruit being longer.

Distrib. of type. South Africa.

CORCHORUS TRILOCULARIS, *Linn. Mant.* 77.

Chipete Forest Patch outskirts, 3800 ft. ; in fl. & fr. May ; n. 469. Upper Buzi, 3800 ft. ; in fr. April ; n. 1480. Chipetzana River, 3000 ft. ; in fr. Apr. ; n. 1481.

Distrib. Widely distributed.

C. SERRÆFOLIUS, *Burch. Trav.* i. 537.

Lower Umswirizwi River, 1000 ft. ; in fl. Nov. ; n. 201. A common herb.

Distrib. South Africa.

GLYPHÆA GREWIOIDES, *Hook. fil. in Hook. Ic. Pl.* t. 760.

Beira open woods, 50 ft. ; in fl. Dec. ; n. 1225. A shrub with yellow flowers.

Distrib. Widely distributed.

LINACEÆ.

ERYTHROXYLON EMARGINATUM, *Thonn.*, var. CAFFRUM, *O. E. Schultz in Engl. Pflanzenr. Eryth.* 136.

Chipete Forest Patch, 3800 ft. ; in fl. Dec., n. 133 ; in fl. Oct., n. 692. Chironda, Lower Buzi, 200 ft. ; in fl. Dec. ; n. 1363. Chimanimani Mts., 7000 ft. ; in bud Sept. ; nos. 1364 & 1365. Mt. Umtereni, 4000 ft. ; in fl. Oct. ; n. 1366. Mt. Maruma, 3500 ft. ; leaves only ; n. 1367.

Distrib. of var. *caffrum.* Angola, Natal, Ressano Garcia.

MALPIGHIACEÆ.

SPHEDAMNOCARPUS PRURIENS, *Szyszyl. in Rozpr. Spraw. Akad. Umiej. Krak.* xviii. (1888) 2, forma.

Chirinda, 3800 ft. ; in fl. & fr. May ; n. 211. Chipete outskirts, 3800 ft. ; in fl. April ; n. 211 *a*. Mt. Maruma, 3500 ft. ; in fl. Sept. ; n. 1759. The leaves in the above specimens are not quite so silvery as in the type.

Distrib. Natal.

GERANIACEÆ.

GERANIUM CAFFRUM, *Eckl. & Zeyh. ex Harvey & Sond. Fl. Cap.* i. 258.

Melsetter, 6000 ft. ; in fl. & fr. Sept. ; n. 790.

Distrib. South Africa.

PELARGONIUM ACONITOPHYLLUM, *Eckl. & Zeyh. ex Harvey & Sond. Fl. Cap.* i. 276.

Mt. Pene, 7000 ft.; in fl. Oct. ; n. 6099. A tall herb with handsome white flowers. It is not the typical form.

Distrib. (of type). Natal, Caffraria, Beira.

IMPATIENS WALLERIANA, *Hook. fil. in Oliver, Fl. Trop. Afr.* i. 302.

Chirinda Forest, especially on Zona, 3700–4000 ft. ; in fl. April ; n. 344. A herb with pink flowers.

Distrib. Mozambique District.

I. ZOMBENSIS, *Baker in Kew Bull.* 1897, 247.

Chirinda Forest, especially on Zona, 3700–4000 ft.; in fl. April ; n. 343. Flowers pink. A form of this plant with the leaves not so sharply serrate as in the type from Mt. Zomba.

Distrib. (of type). Nyasaland.

I. CECILI, *N. E. Brown in Kew Bull.* 1906, 101.

Melsetter, 6000 ft. ; in fl. Sept. ; n. 618.

Distrib. (of type). Manika District of Rhodesia.

OXALIS SEMILOBA, *Sonder in Harvey & Sond. Fl. Cap.* i. 350.
Kurumadzi River, Jihu, 2000 ft.; n. 2064. A herb with pink flowers.
Distrib. Mozambique District, Huilla, South Africa.

O. CORNICULATA, *Linn. Sp. Pl.* 435.
Kurumadzi River, Jihu; in fl. Nov.; n. 2065. A herb with yellow flowers.
Distrib. Widely distributed.

RUTACEÆ.

TODDALIA ACULEATA, *Pers. Syn.* i. 249.
Chipete Forest Patch; in fl. & fr. Nov.; n. 213. A large woody climber with thorns and white flowers.
Kurumadzi River, Jihu, 2000 ft.; in bud Nov.; n. 1240.
Distrib. Widely distributed in the Tropics.

VEPRIS LANCEOLATA, *G. Don, Gen. Syst.* i. 806.
Beira beach sea-level, in bud Dec.: n. 1324.
Distrib. South Africa.

TECLEA NATALENSIS, *Engler, Pflanzenwelt Ost-Afr.* C. 433. (= *Toddalia natalensis*, Sond.)
Chimanimani Mts., 7000 ft.; in bud Sept.; n. 1322. A fair sized tree. Only in bud, further material desirable.
Distrib. Natal.

TECLEA SWYNNERTONII, *E. G. Baker*, sp. nov. (Pl. **2**. figs. 1–5.)
Arbor mediocris, sempervirens, haud armata, ramis novellis fusco-pubescentibus adultioribus glabris; foliis modice petiolatis ternatis, petiolo subtereti superne leviter canaliculato, foliolis coriaceis ovatis vel oblongo-ovatis basi cuneatis apicem versus attenuatis margine integris, nervis lateralibus numerosis tenuibus juxta marginem inter se anastomosantibus, supra nitidis subtus glabris, costa conspicua, breviuscule petiolulatis; floribus unisexualibus, masculinis calyce cupuliformi brevi, petalis 4 oblongis; staminibus 4 petalis fere duplo longioribus; femineis petalis latioribus ovatis acutis; carpellis 2 stigmate peltato sessili; fructu extus glabro glaucescente fere duplo longiore quam lato.
Hab. Melsetter District, Chirinda Forest; n. 12. Chindao name, "Ruanziti." A medium-sized evergreen tree with creamy white flowers.
Petiolus communis 3·0–4·5 cm. longus. Foliola 8·5–12·5 cm. longa, 4·0–6·0 cm. lata. Petioluli 4–6 mm. longi.
Fl. ♂. Petala ± 2 mm. longa. Fructus ± 1 cm. longus.
Differs from *T. nobilis*, Delile, by the longer stamens, broader leaflets, and especially the 2-locular ovary.

Dr. Engler restricts the genus *Teclea* to plants having a one-celled ovary. This plant is closely allied to *Teclea grandifolia*, Engler, which is synonymous with *Zanthoxylon Welwitschii*, Hiern.

Mr. Swynnerton states it is a large diœcious tree 60 or 70 feet in height, common, particularly in its youngest stages, in Chirinda, and found in crowded kloofs and forest-patches elsewhere at from 3000–4000 feet. The fruit is an orange-coloured berry with a netted seed and sweet strongly flavoured pulp, ripens from Sept. to Oct., and is much relished by the Kafirs, trumpeter hornbills, and baboons. Foliage dark glossy and evergreen with a rather turpentine smell when crushed. Probably the local food-plant of *Papilio dardanus.*

CLAUSENA INÆQUALIS, *Benth. in Hook. Niger Fl.* 257.

Jihu, near Spungabera, 3000 ft.; in fl. Oct.; n. 181. Chirinda Forest outskirts, 3700–4000 ft.; in fl. & fr. Sept.; n. 122. Kurumadzi River, Jihu, 2000 ft.; in fr. Nov.; n. 122 *b*. Mt. Maruma, 3500 ft.; in fl. Sept.; n. 122 *a*.

Distrib. South Africa, Nile Land, Mozambique District.

CITRUS AURANTIUM, *Linn. Sp. Pl.* 783.

Chirinda Forest, 3700–4000 ft.; n. 672. A wild orange, occurring sparsely in Chirinda and on the upper banks of the Lusitu River. Flowers white. Fruits large and highly coloured, and scented like a tangerine, but bitter.

SIMARUBEÆ.

KIRKIA ACUMINATA, *Oliver in Hook. Ic. Plant.* t. 1036.

Chibabava, Lower Buzi, 400 ft.; in fl. Dec.; n. 1639. A large tree.

Distrib. Mozambique District.

OCHNACEÆ.

OCHNA LEPTOCLADA, *Oliver, Fl. Trop. Afr.* i. 318.

Chikore Hills, 3500 ft.; in fl. Nov.; n. 1356. A large shrub with whitish flowers. Madanda Forest at about 400 ft.; in fr. Dec.; n. 1361. Mt. Pene, 7000 ft.; in fl. Oct.; n. 6172.

N. 1356 agrees so closely upon dissection with *O. leptoclada*, Oliver, the type of which is in the Kew Herbarium, that I have referred it to this species, the only discrepancy being in the colour of the flowers, which in *O. leptoclada* are said to be gamboge-yellow.

N. 1361 I take to be the same species in leaf at a later stage. The leaves are small, glabrous and coriaceous, sometimes obovate, but generally oblong

or oblong-obla nceolate, 2·04·0 cm. long, serrate at the margin and with rather numerous lateral veins and a very short petiole.

Distrib. Mozambique District.

OCHNA PULCHRA, *Hook. Ic. Plant.* t. 588.

Madanda Forest at about 400 ft.; in fr. Dec.; n. 1360. A small tree, seeds black, calyx carmine. Flowers required to confirm this identification.

Distrib. South Central Region.

OCHNA (Schizandra) CHIRINDICA, *E. G. Baker*, sp. nov.

Arbor mediocris, ramosa; ramulis cortice cinereo-brunneo vel cinereo-nigrescente tectis; foliis interdum cum floribus coëtaneis vel interdum post anthesin enascentibus viridibus papyraceis oblongis vel oblongo-oblanceolatis utrinque attenuatis toto margine plus minus argute serratis apice ipso obtusis basi cuneatis nervis lateralibus arcuatim adscendentibus supra prominulis costæ subrectangulariter insidentibus, petiolo brevissimo; floribus in apice ramorum abbreviatorum lateralium racemosis manifeste pedicellatis, pedicellis gracilibus infra partem $\frac{1}{3}$ inf. articulatis; floribus inter minores generis; sepalis oblongis vel ovato-oblongis striatis in sicco olivaceo-viridibus; petalis obovatis flavis basi in unguem attenuatis; staminibus ultra 20, antheris rimis longitudinalibus dehiscentibus; stylo erecto apice stigmata brevia gerente; ovario sæpissime 5-lobo, lobis extus glabris tenuiter reticulatis.

Hab. Chirinda Forest, 3700 ft.; n. 106. In flower, 9th Oct. 1905. In leaf, May 1906.

A medium-sized deciduous tree, the yellow flowers preceding the leaves. Only one tree found.

Arbor 15–20 m. alt. Folia juniora 8·0 cm., adultiora 9·0–13·0 cm. longa, 2·5–3·3 cm. lata. Petioli 1·0–2·0 mm. longi. Pedicelli $\pm$1–2·5 cm. longi. Sepala $\pm$5·0 mm. longa. Petala $\pm$6–7 mm. longa. Antheræ 1·5 mm. longæ. Stylus $\pm$2·5 mm. longus.

The distinguishing features of this tree are the rather small flowers, racemose at the ends of short lateral branches, which are borne before the leaves, and the oblong, attenuate, distinctly papyraceous leaves with a very short petiole.

The following are also closely allied:—n. 626, a small tree gathered on Mt. Umtereni, alt. 4000 ft.; and n. 193 from the Chipete Forest Patch, alt. 3800 ft.

O. chirindica differs from *O. Holstii*, Engler, by the flowers, which are smaller and preceding the leaves, and by the larger leaves.

O. NATALITIA, *Engler & Gilg in Engler Jahrb.* xxxiii. (1903) 236.

Madanda Forest at about 400 ft.; in fr. Dec.; n. 1357.

Distrib. Natal.

Pleuroridgea zanguebarica, *Van Tieghem in Ann. Sci. Nat.* ser. 8, xvi. (1902) 399.

Brackenridgea zanguebarica, Oliver in Hook. Ic. Plant. t. 1096.

Chirinda lower slopes, 3600 ft.; in fr. Dec.; n. 189. Beira open woods, sea-level; in fr. Dec.; n. 358. Singuni name, "Umeit-umuzi" (kraal-disperser). A large shrub or small tree. *O. alboserrata*, Engler, Jahrb. xvii. 75, is very closely allied to the above.

Distrib. Mozambique District.

BURSERACEÆ.

Commiphora Fischeri, *Engler, Jahrb.* xv. (1892) 97.

Sabi River, 1000 ft.; in fl. Nov.; nos. 1208 & 1450. A tree of the size of *Faurea saligna*, with white flowers. Chindao name, "Igwatigwati."

Distrib. Tropical East Africa. There is another species of *Commiphora* in the collection from Umhlonhlo, Lower Buzi. It is closely allied to *C. pilosa*, Engler, but further material is necessary.

MELIACEÆ.

Ekebergia Meyeri, *Presl, Bot. Bemerk.* 25.

Chirinda Forest, 3700–4000 ft.; in fl. Oct.; n. 18.

Distrib. South Africa. "A large handsome tree, height 90 ft., girth of largest measured 10 ft. 8 ins., reminding one rather of an English ash. It usually begins to branch somewhat low, and forms a fine shady spreading head of rather drooping foliage. Bark grey-brown, rather rough. It flowers early in October (Sept. 30th to Oct. 8th), and the fruits, which are very attractive to touracoes and parrots, ripen in January and continue on the trees till April. It is common along the Chirinda outskirts, and I have noted it also along the Inyamkwha forest patch."

E. arborea, *Bak. fil. in Journ Bot.* xxxvii. (1899) 427.

Near Chirinda, 3700–4000 ft.; in fl. & fr. Oct.; n. 35.

Distrib. Rhodesia. Chindao name, "Mutomo." "A small to medium-sized tree of the open woods, height up to 30 ft., girth up to 18 ins., seldom more. The crown is usually rather uneven and seldom at all dense. Bark thick, somewhat rough, dull grey externally, red when cut into. Timber very soft white right through, there being no apparent division between sapwood and heartwood; a central pith. It is straight-grained and much used by the natives in the manufacture of pillows and bowls. An infusion of the roots is said to be drunk by them for pains in the chest. Not uncommon in the open woods about Chirinda and Chikore."

Trichilia emetica, *Vahl, Symb. Bot.* i. 31.

Delagoa Bay, 150 ft.; in fl. Sept.; n. 6517.

Distrib. Nile Land, Upper Guinea and Arabia, also Natal. There is a type of this species from Forskål in the National Herbarium. In the true plant the leaves are subdensely pilose below.

N. 583 *a* from the Kurumadzi River is closely allied to the above. The Chindao name of this is "Musikini," Singuni "Umkuhlu." N. 583 *a* is a large tree with dense spreading crown of dark glossy leaves and a trunk sometimes 3 ft. or more in diameter, height up to 80 ft. Both in bark and in general growth and height it differs absolutely from *T. chirindensis.*

TRICHILIA (Eutrichilia) UMBRIFERA, *Swynnerton & Bak. fil.*, sp. nov.

Arbor alta et vasta; foliis petiolatis impari-pinnatis 4–5-jugis, foliolis brevissime petiolulatis oppositis vel passim alternis oblongis vel rarius ovatis terminalibus ovato-oblongis superne glabris subtus fusco-pubescentibus junioribus subtomentosis nervis lateralibus patulis utrinque 15–21 ante marginem conjunctis basi cuneatis vel late-cuneatis apice acutis; inflorescentia paniculata, floribus pedicellatis, pedicellis articulatis; bracteis oblongo-ovatis pubescentibus; calyce fere polysepalo extus pubescente lobis apice subobtusis; petalis extus adpresse hirsutis liguliformi-oblongis apice obtusis circiter 3-plo longioribus quam latis; filamentis ad $\frac{1}{2}$ altitudinis in tubum extus glabrum coalitis sursum laciniosis laciniis intus hirtis laciniarum dentibus subulatis; antheris glabris; stylo erecto præcipue inferne plus minus pilis vestito, stigmate crasso; ovario 3-loculari extus pilis albis vestito.

Inter species africanas hujus generis calyce fere polysepalo et foliolorum nervis numerosis recognoscenda.

Hab. Melsetter District, Lower Umswirizwi, 1000 ft.; n. 148.

Folia 20–30 cm. longa. Foliola 6·0–10 cm. longa. Calyx 4·0–4·5 mm. longus. Petala 12·0–15·5 mm. longa, ±4·5–5·0 mm. lata. Tubus stamineus cum laciniis ±9 mm. altus. Stylus ±8 mm. longus. Antheræ ±1·5 mm. longæ.

A large tree with shady foliage, growing on the banks of the river; the flowers were already dry, the tree having been caught evidently by the grass-fires when in flower; the upper branches were bearing young fruits resembling those of n. 1 (*T. chirindensis*).

A closely allied plant, n. 584, was obtained on the Sabi River at 1000 ft. on the 9th of November. It nearly agrees with the above in the structure of the flowers, but differs in having the leaflets obtuse.

Allied to *T. strigulosa*, Welw.; differs in the leaves having generally five pairs of leaflets and being subtomentose or pubescent, hardly villous, below, and in the shorter and broader petals.

TRICHILIA (Eutrichilia) CHIRINDENSIS, *Swynnerton & Bak. fil.*, sp. nov.

Arbor vasta et altissima, corona ampla, cortice lævi pallide griseo, ligno flavo-rubescente; foliis petiolatis 2–4-jugis, foliolis breviter petiolulatis

oblongo-ellipticis vel obovato-ellipticis vel ellipticis basi rotundatis apice sæpissime rotundatis interdum retusis utrinque præter nervos glabris nervis lateralibus foliolorum anticorum 10–13 posticorum 6–9 superne haud prominentibus subtus prominulis, rhachi tomentosa ; paniculis axillaribus vel in ramis lateralibus plus minusve foliis pluries brevioribus ramulosis ; floribus brevissime pedicellatis ; calyce fere polysepalo, sepalis late ovatis subobtusis margine ciliatis extus adpresse fusco-hirtis lamellatis ; petalis oblongis superne dense puberulis apice obtusis vel interdum truncatis ; filamentis usque ad medium in tubum sursum laciniosum coalitis, tubo 10-antherifero extus inferne glabro, laciniis apice 2-denticulatis intus dense villosis extus dorso glabris ; antheris glabris curvatis ; ovario 3-loculari extus hirto ; stylo erecto tenuiter patenti-hirto ; stigmate sublobato capitato ; seminibus arillo in sicco flavo-rubro vestitis.

Hab. Chirinda Forest, alt. 3700–4000 ft. ; n. 1. Native name "Umkuhlu." One of the largest forest trees. Flowers dull white. Bark smooth, light grey, tinged with pink.

Arbor usque ad 40 m. attingens Sept.–Oct. florens. Folia 15–30 cm. longa. Foliola 10–14·0 cm. longa ; foliolorum petioluli 4–5 mm. longi. Calyx ±4 mm. longus. Petala ±15 mm. longa, ±4 mm. lata. Tubus stamineus cum laciniis ±1·0 cm. longus. Antheræ ±2 mm. longæ. Stylus cum ovario vix 9 mm. longus.

This species differs from *T. vestita*, C. DC., in the nearly polysepalous calyx—the leaves, which are glabrous below—the less hairy style—the larger stigma—and the glabrous teeth of the laciniæ. From *T. Stuhlmanni*, Harms, in the broader leaflets and the nearly polysepalous and larger calyx. From *T. Dregei*, E. Meyer, in the leaves not being acuminate at the apex. From *T. Dregei*, E. Meyer, *β oblonga*, Harvey, in the longer lateral leaflets.

N. 1119 from Bunda River, not in flower, is probably also a *Trichilia*. It is a tree growing in a patch of forest.

"One of our finest forest trees, and with its spreading head of dark glossy leaves it is one of the best shade trees. It is far larger than *Trichilia emetica*, Vahl, reaching in the forest a height of 120 feet or more, with a trunk diameter of as much as 7 ft. 6 in. and a spread of crown of 60 ft. or more. The timber is reddish brown in colour and easily worked, and is on this account a favourite with the natives, who display some skill in carving it into pillows, spoons, &c. The trunk usually runs up to a considerable height before branching."

The following clavis shows the position of these novelties with regard to their allies :—

A. Calyx ad medium vel ultra medium 5-lobatus. Foliolorum nervis secundariis 8–12.

T. Stuhlmanni, Harms. Lake Region.

B. Calyx ultra medium vel interdum fere ad basin lobatus. Petala 12·0–15·5 mm. longa.

a. Folia demum præter nervos fere glabra. Foliolorum nervis secundariis 10–13.

T. chirindensis, Swynnerton & Bak. fil. Gazaland.

β. Folia subtus fusco-pubescentia. Foliolorum nervis secundariis numerosis (18–21).

T. umbrifera, Swynnerton & Bak. fil. Gazaland.

C. Calyx obtuse 5-dentatus. Foliolorum nervis secundariis 9–12. Petala circiter 7 mm. longa (*fide* C. DC.).

T. Dregei, E. Meyer. Port Natal.

D. Calyx profunde obtuse 5-dentatus. Folia subtus subdense pilosa. Foliolorum nervis secundariis ±12. Petala 10–13 mm. longa.

T. emetica, Vahl. Nile Land, Upper Guinea, Mozambique District, Arabia.

Lovoa Swynnertonii, *E. G. Baker*, sp. nov. (Pl. **3**.)

Arbor excelsa ramulis cortice cinereo tectis ; foliis 3–8-jugis (sæpissime 6–8), rhachi angulari tenuiter pubescente, foliolis suboppositis vel oppositis subcoriaceis inæquilateraliter oblongis apice subacuminatis apice ipso obtusis basi cuneatis in petiolulum attenuatis utrinque glabris superne nitidis nervis lateralibus numerosis supra paullulo prominulis subtus prominulis ; inflorescentia paniculata in statu juvenili fusco-pubescente ramulis dichotome ramulosis, pedicellis brevibus ; calyce brevi e sepalis 4 suborbicularibus imbricatis composito ; petalis albis ovali-oblongis concavis ; tubo stamineo extus glabro margine in crenas bifidas cum filamentis alternantibus exeunte ; antheris 8 in summo tubo stamineo insertis ; ovario disco intra tubum stamineum circumdato ; stylo brevi, stigmate discoideo capitato ; fructu capsulari columna centrali quadrangulari 4-valvi, seminibus alatis.

Hab. Chirinda Forest, 3700–4000 ft. ; n. 16.

"Brown Mahogany" of settlers. The largest, excepting perhaps *Khaya nyasica*, of the Chirinda trees. Flowers white.

Arbor usque ad 50 m. alt. attingens. Folia 15–30 cm. longa. Foliola 6·5–10·0 cm. longa, foliolorum petioluli 3–7 mm. longi. Calyx 1·0–1·5 mm. longus. Petala 3·0–3·5 mm. longa, ±2·0 mm. lata. Tubus stamineus ±2·0 mm. altus. Antheræ vix 1 mm. longæ. Semina cum alis 3·5–4·5 cm. longa. Capsula ± 5 cm. longa.

The staminal tube bears at its apex 8 bifid crenations. The 8 stamens alternate with these crenations, the filaments are considerably shorter than the anthers. The 4-valved capsule has generally two perfect seeds in each cell. The seeds are long-winged above.

"A huge tree attaining occasionally a height of 160 feet, and strongly resembling *Khaya nyasica*, Stapf, in its habit of growth, its bark and general

appearance. It usually runs up straight to 90 ft. or so before commencing to branch, and never attains quite the same girth, the largest specimen I have seen measuring barely 8 ft. in diameter. Diameters of 4–6 ft. are not uncommon. Bark light grey, smooth but often much laminated, and lacking the bitter taste of *Khaya nyasica.* Red where cut. Heartwood a deep grey-brown in colour, sapwood dull whitish. The timber is handsome, but frequently cross-grained and difficult to work. It has been used a great deal locally for outdoor work, being very durable and untouched by insects. The crown of the tree is frequently not very large in proportion to its height. The foliage where exposed to sunlight is dark green and glossy, and the young leaves are pale green. The trees are in full bloom in January. So far as I know at present, the tree grows only in Chirinda, where it prefers well-drained slopes to banks of streams."

KHAYA NYASICA, *Stapf MS. in Herb. Kew,* sp. nov.

Khaya senegalensis, A. Juss.; Oliver in Fl. Trop. Afr. i. 338, quoad plantam mossambicensem.

Arbor vasta, ligno duro rubescente (sec. cl. detectorem), ramis erecto-patulis imprimis apicem versus foliosis; foliis paripinnatis 3–5-jugis foliolis sæpissime oblongis latioribus quam in *K. senegalensis* apicem versus subito attenuatis marginibus subparallelis, petiolulis longioribus; floribus albis paniculatis; stigmate breviter cylindrico apice subconico; stylo brevi, tubo stamineo non constricto.

Hab. Lower Umswirizwi River and Chirinda Forest; n. 15.

Chindao name, "Muwawa." Singuni name, "Umbaba."

Arbor usque ad 45 m. alt. attingens, trunco ad basin sæpe ±3 m. diam. Folia 15–32·0 cm. longa. Foliola ±4·3–11·5 cm. longa, 2·4–4·0 cm. lata. Calyx 1·0–1·4 mm. longus. Petala ±3·0–4·0 mm. longa. Tubus stamineus 3·0–3·5 mm. longus.

This species differs from the plant figured by Guillemin and Perrottet in their Fl. Seneg. t. 34, by the leaves being more generally oblong and more abruptly attenuate at the apex, the longer petiolules and shorter style. The flowers of Perrottet n. 130 will be found on dissection to differ in certain particulars from the structure of the plant as figured.

Distrib. Mozambique, Nyasaland.

"A huge tree attaining a height of 150 ft. or more, and exceptionally a diameter of 15 ft.; one that I measured in the Inyamkuwha forest patch having attained this diameter at 8 ft. from the ground just above the buttresses. Diameters of 5–8 ft. are not uncommon. The trunk is almost invariably very straight, and runs up to a considerable height before branching; the young saplings have much the appearance of young *Castilloa elastica.* Bark light grey, thick, smooth or laminated, astringent in taste, reminding one of quinine, hence the native name "Umbaba," meaning to be bitter.

Timber red in colour with a handsome grain, hard, but fairly easily worked and weathers well above ground. It is untouched by Bostrychidæ or termites, and has a probably ill-founded reputation for durability below ground. The tree makes an enormous crown of handsome glossy foliage, and is usually to no great extent deciduous and by no means a favourite with locusts. The old trees are in full bloom at the commencement of November, and the fruits commence to ripen at the end of the following September, continuing to fall till December and littering the ground for some distance in every direction. The seeds are crushed and boiled by the natives, the resulting oil, which is said to have a bitter taste, is rubbed by them into their hair to kill vermin."

OLACINEÆ.

Ximenia americana, *Linn. Sp. Pl.* 1193.

Open spaces near Chirinda, 3500 ft.; in fl. Oct.; n. 175. Beira open woods, 100 ft.; in fr. Dec.; n. 1128.

A specimen from S. Umtali, n. 6619, is closely allied, but is somewhat pubescent.

Distrib. Widely distributed.

Apodytes dimidiata, *E. Mey. ex Bernh. in Linnæa*, xii. (1838) 136.

Kloof near Chirinda, 3800 ft.; n. 184.

Distrib. South Africa, Lower Guinea, Nile Land.

Olax Stuhlmanni, *Engler in Notizbl. K. Bot. Garten, Berl.* ii. 283.

Boka, Lower Buzi, 100 ft.; in fr. Dec.; n. 1196. A large shrub on limestone.

Distrib. Lourenço Marques.

Opilia amentacea, *Roxb. Pl. Coromandel*, ii. 31, t. 158.

Sabi River at about 1000 ft.; in fl. Nov.; n. 1204. A climbing shrub with yellow flowers.

Distrib. Widely distributed.

Pyrenacantha kamassana, *Baill. Adansonia*, x. (1872) 272.

Madanda Forest, 400 ft.; in fr. Dec.; n. 2067. A climber on the ant-heaps at Ancate.

Distrib. Mozambique District.

ILICINEÆ.

Ilex mitis, *Radl. in Act. Congr. Bot. Anvers* (1887) 172.

Mt. Pene, 7000 ft.; in fl. Oct.; n. 6210.

Distrib. South Africa, Mozambique District, Madagascar.

CELASTRINEÆ.

GYMNOSPORIA SENEGALENSIS, *Loes. in Bull. Herb. Boiss.* iv. 430.

Upper Buzi at 3500 ft.; in fl. May; n. 2069. A large thorny shrub with pale greenish flowers.

Distrib. Widely distributed in Tropical Africa.

G. BUXIFOLIA, *Szyszyl. in Rozpr. Spraw. Akad. Umiej. Krak.* xviii. (1888) 34.

Mt. Maruma, 3500 ft.; in fl. Sept.; n. 2068. A large thorny shrub with pale greenish flowers.

Distrib. South Africa, Mozambique District.

CELASTRUS MOSSAMBICENSIS, *Klotzsch in Peters Mossamb. Bot.* i. 112.

Chikore Hills, 3500 ft.; in fl. April; n. 185. A low plant with white flowers. N. 185 agrees with *Celastrus rubra*, Herb. Sonder, which was referred by Prof. Oliver (Fl. Trop. Afr. i. 362) to *Celastrus mossambicensis*, Klotzsch.

Distrib. Mozambique District.

C. CONCINNUS, *N. E. Brown in Kew Bull.* 1906, 16.

Chirinda outskirts, 3700–4000 ft.; in fl. & fr. Oct.; n. 118. A thorny shrub with white petals, pink and green sepals, and red berries.

Distrib. Natal.

CATHA EDULIS, *Forsk. Fl. Æg.-Arab.* 63.

Chipete outskirts, 3800 ft.; in fl. April; n. 102.

"Chirinda Redwood." One of the largest forest trees, very rough-barked; timber red, handsome. Far commoner in Chipete than in Chirinda, where I know only of one of the large specimens. These flowers (white) are from young trees which have sprung up and are growing rapidly on the sheltered face of Chipete, and which, by comparison of bark, leaves and small seedlings with seeds attached, I believe to be identical with the large specimens inside Chipete.

Chirinda Forest, 3700–4000 ft.; in fl. May; n. 102. Near Chirinda, 3500 ft.; in fr. Oct.; n. 1342. A smallish tree with creamy white flowers and red durable timber. Chindao name, "Mutsawhari."

Kurumadzi, Jihu, 2000 ft.; in fl. Aug.; n. 1341.

Distrib. Nile Land, Nyasaland, German East Africa.

PTEROCELASTRUS ROSTRATUS, *Walp. Rep.* i. 535.

Mt. Pene Forest, 6500 ft.; in fl. Sept.; n. 1301. Chimanimani Mts., 7000 ft.; in fl. Sept.; n. 1302. A tree with pale greenish or creamy flowers.

Distrib. South Africa.

ELÆODENDRON CAPENSE, *Ecklon & Zeyher, Enum.* 127.

Chikore, 3600 ft.; in fl. March; n. 167. Chirinda outskirts, 3700–4000 ft.; in fl. Oct.; n. 1174.

Distrib. South Africa.

HIPPOCRATEA OBTUSIFOLIA, *Roxb. Hort. Beng.* 5.

Sabi River at about 1000 ft.; in fl. Nov., n. 1200; in fr. Nov., n. 1203.

Distrib. Widely distributed in Africa and also in India.

RHAMNACEÆ.

ZIZYPHUS MUCRONATA, *Willd. Enum. Hort. Berol.* 251.

Bumbo, 400 ft.; in fl. Dec.; n. 1047. Gambadziya River, 3300 ft.; in fr. May; n. 1385. Kurumadzi; in bud Nov.; n. 2069 *a*. Umvumvumvu River, 4000 ft.; in fr. April; n. 2070. Chindao name, "Chinanga."

Distrib. Widely distributed in Tropical and South Africa.

BERCHEMIA DISCOLOR, *Hemsley in Oliver, Fl. Trop. Afr.* i. 381.

Chibabava, Lower Buzi, 400 ft.; in fl. Dec., n. 1340; and in bud Dec., n. 1409. A fairly large tree. Sabi River, 1000 ft.; in fl. Nov.; n. 1215. Chindao name, "Munye."

Distrib. Mozambique District, Amboland.

RHAMNUS PRINOIDES, *L'Hérit. Sert. Angl.* 6, t. 9.

Chipete outskirts, 3800 ft.; in fr. May; n. 428. A large shrub with red fruits and whitish flowers.

Distrib. Nile Land, South Africa, German East Africa, Natal.

PHYLICA PANICULATA, *Willd. Sp. Pl.* i. 1112.

Chimanimani Mts., 7000 ft.; in fr. Sept.; n. 632 *a*.

Distrib. South Africa, Natal.

COLUBRINA ASIATICA, *Brongn. in Ann. Sci. Nat.* sér. 1, x. (1827) 369.

Beira beach; in fr. Dec.; n. 1127.

Distrib. Mozambique. Common throughout Tropical Asia, but has not been recorded from Natal.

HELINUS MYSTACINUS, *E. Meyer, ex Steud. Nom.* ed. II. i. 742.

Chirinda outskirts, 3700–4000 ft.; in fl. & fr. May; n. 217.

Distrib. Nile Land, German East Africa, Uganda.

GOUANIA LONGISPICATA, *Engler in Pflanzenwelt Ost-Afr.* C. 256, ex descript.

Chirinda Forest, 3700–4000 ft.; in fl. April; n. 96. A large woody climber with flowers very attractive to sun-birds.

Distrib. Mozambique District.

LASIODISCUS HOLTZII, *Engler, Jahrb.* xl. (1908) 551.

Chirinda Forest, 3700–4000 ft.; in fl. & fr. Oct., n. 121; and in young fr. Dec., n. 6227. A shrub 7–8 ft. high. Perianth green; anthers dull orange; pistil and disc pale yellowish.

Boka, Lower Buzi; in fr. Dec.; n. 1038. A large shrub on limestone. This species is only known to me from the description; the specimens agree except in the more glabrous character of the inflorescence.

Distrib. Zanzibar Coast Region.

AMPELIDEÆ.

AMPELOCISSUS MOSSAMBICENSIS, *Planch. in Journ. Vigne Am.* (1885) 49; *in DC. Monogr. Phan.* v. 392.

Jihu rise, between Zona and Kurumadzi, 2400 ft.; n. 223. Also Jihu; n. 1371. Madanda Forest at about 400 ft.; n. 1372. A grape vine common in the Jihu, and hardly less so in portions of the higher veldt.

Distrib. Mozambique District.

CISSUS ROTUNDIFOLIA, *Vahl, Symb.* iii. 19.

Sabi River, 1000 ft.; in bud Nov.; n. 2071. Boka, Lower Buzi, 100 ft.; in young fr. Dec.; n. 2072. A large fleshy climber with whitish flowers.

Distrib. Arabia, Nile Land, Mozambique District.

C. INTEGRIFOLIA, *Planch. in DC. Monogr. Phan.* v. 483.

Vitis integrifolia, Baker in Oliver, Fl. Trop. Afr. i. 391.

Kurumadzi River, Jihu, 2000 ft.; in bud Nov.; n. 2073. Chibabava, Lower Buzi, 400 ft.; n. 2075. Umswirizwi River, 1000 ft.; in bud Nov.; n. 2074. A climber.

Distrib. Mozambique District.

C. BUCHANANI, *Planch. in DC. Monogr. Phan.* v. 601.

Kurumadzi River, Jihu, 2000 ft.; in fl. Nov.; n. 1377. Chipete, 3800 ft.; in fr. March; n. 231. A common climber.

Distrib. Nyasaland.

C. ZOMBENSIS, *Gilg & Brandt, MS. in Herb. Kew., comb. nov.*

Vitis zombensis, Baker in Kew Bull. 1898, 302.

Grass veldt near Chirinda, 3500 ft.; in fr. Sept.; n. 194. A low upstanding plant 2–3 ft., with purple-black edible fruits, ripe in December. This is a form in which the leaves are distinctly more serrate than in the type.

Distrib. Nyasaland.

RHOICISSUS CAPENSIS, *Planch. in DC. Monogr. Phan.* v. 463.

Chirinda outskirts, 3700–4000 ft.; in fl. Nov.; n. 1370. Mt. Maruma, 3500 ft.; in bud Sept.; n. 1378. Chikore Hills, 3700–4000 ft; in bud Nov.; n. 1376.

Distrib. Natal, Cape, German East Africa.

RHOICISSUS CUNEIFOLIA, *Planch. in DC. Monogr. Phan.* v. 466.

Near Chirinda, 3800 ft. ; in bud Nov. ; n. 221. Chindao name, "Chidzamahausi."

Distrib. Natal, South Africa.

A shrub with trailing twigs and small edible fruits, common in long grass about Chirinda and noticed in the somewhat denser bush about Maruma. It occurs in the Jihu even in the dense bush, but is less common than *R. sansibarensis*, Gilg. The roots take the form of long, hard tubers, and are a great obstacle to the plough, greatly increasing the cost of cultivation when present. These roots are pounded up by the natives and mixed with meal to form a thin porridge for pains in the chest.

R. RHOMBOIDEA, *Planch. in DC. Monogr. Phan.* v. 467.

Mt. Pene Forest, 6500–7000 ft. ; n. 1382. Chimanimani Mts., 7000 ft. ; n. 1381. Chirinda Forest outskirts, 3700 ft. ; in fr. Oct. ; n. 92. A grape vine common in forest outskirts.

Distrib. Natal.

R. SANSIBARENSIS, *Gilg in Engler, Glied. Veg. Usamb.* [*Abh. Preuss. Akad. Wiss.* (1895)] 53 ; *in Engler, Pflanzenwelt Ost-Afr.* C. 257.

Madanda Forest, 4000 ft. ; in bud Dec. ; n. 1374. Jihu rise, between Zona and Kurumadzi ; in bud Jan. ; n. 222. Lusitu River at about 3000 ft. ; in fr. April ; n. 1380. N. 1375 from Kurumadzi, and n. 1379 from Umvumvumvu, are allied to the above. Chindao name, "Chidzamahausi."

Distrib. Mozambique District. "Very common throughout Jihu even in denser bush, mostly as a dense rounded shrub with trailing branches, but when it gets the chance often throwing these trailers on to some tree stronger than itself and ascending to a height of as much as 40 ft. Flowers nearly over on Nov. 21st, a few fruits then already ripe (black), but numbers of shrubs still only in bud. Noted at Arucate on the ant-heaps and in the Inyamadzi Valley."

SAPINDACEÆ.

The collection contains *Cardiospermum Halicacabum*, Linn., from Chibabava ; *Paullinia pinnata*, Linn., from Chibabava and banks of Lower Umswirizwi ; and *Dodonæa viscosa*, Jacq., from Nyahodi River.

PHIALODISCUS PLURIJUGATUS, *Radl. in Sitz. Math.-Phys. Akad. Muench.* xx. (1890) 263.

Chibabava, Lower Buzi ; in fr. Dec., n. 582 ; and in bud Dec., n. 1037. A large shady tree with handsome clusters of bright pink fruits, making a great show at a distance. Chindao name, "Masadema."

Distrib. Angola.

ALLOPHYLLUS CHIRINDENSIS, *E. G. Baker*, sp. nov.

Arbuscula ramulis nodulosis cortice griseo tectis ; foliis manifeste petiolatis, petiolo sparsissime pilosulo superne leviter canaliculato, foliolis papyraceis oblongis vel obovato-oblongis vel lateralibus oblique ovato-oblongis intermedio basin versus sensim longe cuneato-angustato apice acuminatis apice ipso obtusis lateralibus basi cuneatis omnibus in parte $\frac{4}{5}$ superiore grosse crenato-serratis utrinque glabris subtus costarum axillis pubescentibus exemptis nervis venisque utrinque æqualiter prominentibus venis reticulatis ; inflorescentia pseudo-paniculata foliis sæpe semiæquali ; floribus brevipedicellatis pro genere mediocribus semper in cymulas 2–5-floras pedicellatas inferne remotas superne approximatas dispositis, rhachi pedicellis calycibusque pilosulis ; floribus generis ; baccis (sec cl. detectorem) rubris.

Hab. Common in Chirinda Forest. 3700–4000 ft. ; n. 112.

Arbuscula. Petiolus 6·0–7·5 cm. longus. Foliola lateralia 11·0–13·0 cm. longa, 4·5–5·8 cm. lata, intermedia 15·0–18·0 cm. longa. Pedicelli 1·0–2·0 mm. longi. Calyx ± 1·5 mm. longus.

A small tree with white flowers and red berries.

Allied to *A. Welwitschii*, Gilg ; differs by the cuneate base of the lateral leaflets and the large flowers.

LECANIODISCUS FRAXINIFOLIA, *Baker in Oliver, Fl. Trop. Afr.* i. 429.

Madanda Forest at about 400 ft. ; in fl. Dec. ; n. 524. A large shady tree. Flowers light green with pale yellow anthers. Singuni name, "Umtalala." Chibabava, Lower Buzi, 400 ft. ; in fl. Nov., n. 524 *a* ; and in fl. Dec., n. 1398.

Distrib. Mozambique District.

BERSAMA SWYNNERTONII, *Bak. fil. in Journ. Bot.* xlv. (1907) 14.

Chipete Forest Patch, 3800 ft. ; in fl. Dec. ; n. 9. A fair sized forest tree. Flowers purplish pink.

Distrib. Melsetter.

B. NYASSÆ, *Bak. fil. l. c.* 19, forma.

Jihu, Lower Zona, in fl. Nov. ; n. 40. Chindao name, "Munya Lawa." A medium sized tree of the kloofs and thickets. Jihu District, near Chinyika, 2000 ft. ; in fl. Nov. ; n. 1369.

Distrib. Nyasaland.

ANACARDIACEÆ.

HEERIA INSIGNIS, *O. Kuntze, Rev. Gen.* 152.

Beira Beach sea-level ; in fr. Dec. ; n. 554. A large shrub with milky latex.

Distrib. Widely distributed in Tropical Africa.

Var. RETICULATA, *Bak. fil. in Journ. Bot.* xxxvii. (1899) 428.

Between Mt. Pene and Haroni River, 6000 ft. ; in fr. Sept.; n. 680. A shrub with milky latex and black fruits, scattered here and there in long grass.

Distrib. Rhodesia.

Dr. Engler in Sitzb. Akad. Berlin, ii. (1896) 891, raises this to specific rank.

RHUS TOMENTOSA, *Linn. Sp. Pl.* 266.

Melsetter, 6000 ft.; in fl. Sept.; n. 667.

Distrib. Cape, Transvaal.

R. LUCIDA, *Linn. Sp. Pl.* 267.

Chimanimani Forests, 6500 ft.; in fl. and young fr. Sept.; n. 635. A small-leaved shrub occasionally becoming a small tree, very common in Chimanimani forest patches.

Distrib. Natal, South Africa.

RHUS CHIRINDENSIS, *E. G. Baker*, sp. nov.

Frutex ramulis purpureis subfulvo- vel fusco-pubescentibus; petiolo foliola lateralia vix æquante; foliolis ovato-lanceolatis acuminatis basi late cuneatis subsessilibus vel in petiolulum brevem contractis margine integris vel undulatis nervis lateralibus tenuibus arcuatim patentibus utrinque prominulis demum glabris subtus pallidioribus costa superne prominente; paniculis axillaribus et terminalibus multiramosis cinereo- vel fusco-pubescentibus multifloris; bracteolis minutis; pedicellis tenuissimis; floribus inter minores generis; calycis segmentis ovatis obtusis; petalis quam sepalis 2–3-plo longioribus ovatis; staminibus quam petalis brevioribus; drupis subglobosis glabris.

Hab. Kloof near Chirinda, 3800 ft.; n. 168.

Foliorum petiolus 3·0–4·0 cm. longus; foliola lateralia 3·0–6·0 cm. longa, 1·8–2·5 cm. lata, intermedium 8·0–10·0 cm. longum. Sepala 0·5 mm. longa. Petala ± 1·5 mm. longa, vix 1 mm. lata.

The distinguishing features of this shrub are the trifoliolate, ovate, acuminate leaflets and the axillary and terminal, many-branched, pubescent panicles of small flowers. Allied to *R. glutinosa*, Hochst.; it differs from it by the laxer panicle, and from *R. huillensis*, Engler, var. *acutifoliata*, Engler, by the larger leaves which are at length glabrous.

The following clavis indicates the position of this plant:—

a. Rami dense subfulvo-pubescentes. Foliola apice acuminata. Calycis segmenta ± 0·5 mm. longa.

Rhus chirindensis, E. G. Baker.

β. Rami glabri. Foliola apice acuminata. Calycis segmenta vix 0·5 mm. longa.

Rhus lævigata, Linn.

γ. Ramuli pilosi. Foliola apice acuta vel acuminata. Calycis segmenta 1·0 mm. longa.

Rhus glutinosa, Hochst.

RHUS SONDERI, *Engler in DC. Monogr. Phan.* iv. 435.

Near Chirinda, alt. 3500 ft.; in fl. & fr. Oct.; n. 174. Chipete Forest Patch, alt. 3800 ft.; in fl. Oct.; n. 174 *a*. A shrub with small greenish-yellow flowers. Also perhaps specimens from Chipetzana source at 4000 ft.

Var. PILOSA, Engler; Melsetter, alt. 6000 ft.; n. 6165.

Distrib. Natal, Transvaal, Caffraria.

ODINA EDULIS, *Sond. in Harv. & Sond. Fl. Cap.* i. 503.

Near Chirinda, 3800 ft.; in fl. and fr. Oct.; n. 441. Madanda Forest at about 400 ft.; in fr. Dec.; n. 1034. A somewhat large tree, growing both in dense rubber forests and in more open ant-heap bush at Ancate.

Distrib. South Africa, Natal.

O. STUHLMANNI, *Engl. Pflanzenwelt Ost-Afr.* C. 244.

Madanda Forest, 400 ft.; in fr. Dec.; n. 1754. Sabi River, 1000 ft.; in fl. Nov.; n. 1205.

Distrib. Mozambique District.

SCLEROCARYA CAFFRA, *Sond. in Linnæa*, xxiii. (1850) 26.

Sabi River; in fr. Nov.; n. 1210. Chindao name, "Munganu." A large tree with large edible fruits.

Distrib. Natal, Transvaal, Mozambique District, Madagascar.

CONNARACEÆ.

AGELÆA NITIDA, *Solander, ex Planch. in Linnæa*, xxiii. (1850) 437.

Maruma Forest Patch, 3500 ft.; in fl. Oct.; n. 640. Chirinda, 3800 ft.; in fl. Oct., in fr. Feb.; nn. 228 & 228 *a*. A large woody vine with white, sweet-scented flowers.

Distrib. Upper Guinea.

CNESTIS NATALENSIS, *Planch. & Sond. ex Harv. & Sond. Fl. Cap.* i. 528.

Maruma Forest Patch, 3700 ft.; in fl. Oct., n. 682; in fr. Sept., n. 1348. Near Chirinda, 3700–4000 ft.; in fl. Dec.; n. 166. Chindao name, "Musunzi." A large woody climber occurring in Chirinda (outskirts), Chipete and the glens and patches of trees in the neighbourhood, also the Maruma Forest Patch.

Distrib. Natal.

LEGUMINOSÆ.

The following commoner species are in the collection:—*Argyrolobium Andrewsianum*, Steud., from Chirinda, Kurumadzi, and Melsetter; *Sesbania punctata*, DC., from Chibabava; *Zornia tetraphylla*, Michx., from Chirinda; *Desmodium latifolium*, DC., from Chirinda; *D. gangeticum*, DC., from Madanda Forest; *D. Scalpe*, DC., from Chirinda; *Pseudarthria Hookeri*, Wight & Arn., from Chirinda, &c.; *Alysicarpus rugosus*, DC., from Umtefu, Lower Buzi; *Abrus precatorius*, Linn., from Beira; *Glycine javanica*, Linn., from Chirinda; *Dumasia villosa*, DC., from Chipete Forest; *Canavalia obtusifolia*, Linn., from Beira; *C. ensiformis*, DC., from Chirinda; *Eriosema cajanoides*, Hook. fil., from Chirinda and Chikore Hills; *Swartzia madagascariensis*, Desv., from S. Umtali and Umvumvumvu; *Cassia occidentalis*, Linn., from Chibabava; *C. mimosoides*, Linn., from Chirinda and Lower Umswirizwi River; *Tamarindus indicus*, Linn., from Chibabava; *Burkea africana*, Benth., from Chirinda; *Mimosa asperata*, Linn., from Chibabava.

LOTONONIS ARISTATA, *Schinz*, var. GAZENSIS, *E. G. Baker*, var. nov.

Rami teretes erecti. Folia quam in typo minora, anguste oblonga vel anguste lanceolata, basi attenuata, apice obtusiuscula et longe aristata. Flores in racemos plurifloros dispositi vel solitarii.

Hab. Chimanimani Mts., 7000 ft.; in fl. Sept.; n. 1418. S.E. Rhodesia, Melsetter, 6000 ft.; in fl. Oct.; n. 6196.

The type was described by Dr. Schinz in Bull. Herb. Boiss. vii. (1899) 32, from Houtbosch and Barberton in the Transvaal.

Folia 10–15 mm. longa, 2·0–3·5 mm. lata.

In Medley Wood's List of the Flora of Natal, 17 species of *Lotononis* are stated to occur in that Colony.

CROTALARIA (Oliganthæ) GAZENSIS, *G. E. Baker*, sp. nov.

Frutex ramis ramulisque teretibus tenuiter pubescentibus; foliis mediocriter petiolatis trifoliolatis, foliolis oblanceolatis vel oblongo-oblanceolatis apice rotundatis et mucronatis basi longe cuneatis junioribus utrinque pubescentibus adultioribus demum superne glabris subtus strigoso-pubescentibus costa centrali subtus conspicua superne impressa; stipulis minimis quam petiolis multoties brevioribus; floribus apicem versus ramulorum dispositis paucis; pedicellis tenuibus pubescentibus bracteolis 2 minimis suffultis; calycis segmentis lanceolatis quam tubo longioribus; floribus (sec. cl. detectorem) luteis; vexillo quam calyce longiore basi unguiculato; alis oblongis basi unguiculatis; carina dorso rotundata apice acuta; ovario basi stipitato multiovulato; legumine extus dense pilis fulvis obtecto quam calyce 3–4-plo longiore.

Hab. Nyahodi River at about 5000 ft.; in fl. & fr. April; n. 1493.

"A small shrub with yellow flowers."

Foliola intermedia usque ad 22 mm. longa; lateralia 10 15 mm. longa. Calyx 7–8 mm. longus, segmenta ± 5·0 mm. longa. Vexillum ± 1 cm. longum. Alæ ± 1·0 cm. longæ. Carina ± 1 cm. longa. Legumen 20–22 mm. longum.

Differs from *C. Forbesii*, Baker, by the carina being not long-rostrate at the apex.

The distinguishing characteristics of this species are the trifoliolate leaves with oblanceolate leaflets, the comparatively few flowers, the yellow petals, the keel which is about 1 cm. long and dorsally rounded with a short acute apex, and the many-seeded oblong pods.

CROTALARIA ELATA, *Welw. ex Baker, in Oliver, Fl. Trop. Afr.* ii. 29.

Near Chirinda, 3500 ft.; in fl. April; n. 373. A fair-sized shrub with yellow flowers.

Distrib. Angola, Nyasaland.

C. RECTA, *Steudel, ex A. Rich. Tent. Fl. Abyss.* i. 152.

Near Chirinda, 3800 ft.; in fl. Nov.; n. 365.

Distrib. Nile Land, Mozambique District.

C. NATALITIA, *Meissn. in Hook. Lond. Journ. Bot.* ii. (1843) 67.

Chipete Forest Patch, 3800 ft.; in. fl. May; n. 478. Nyahodi River, 5000 ft.; in fl. April; n. 1494. A tall herb with yellow flowers. *C. kilimandscharica*, Taubert, is synonymous with this species.

Distrib. Natal, Nyasaland, Lower Guinea, German East Africa.

C. MOSSAMBICENSIS, *Klotzsch in Peters Mossamb. Bot.* i. 60, t. 10.

Chirinda outskirts, 3700–4000 ft.; in fl. & fr. May; n. 479. A tall herb; flowers yellow with brown stripes. This is the same as Hildebrandt n. 1392, from the Island of Mombassa. Closely allied plants with longer bracts are n. 1498 from Inyamadzi Valley, 2500 ft., and n. 397 from Chirinda, 3800 ft. A small bush with yellow flowers.

Distrib. Mozambique District.

PSORALEA FOLIOSA, *Oliver in Journ. Linn. Soc., Bot.* xxi. (1885) 399; var. GAZENSIS, *E. G. Baker*, var. nov.

Caulis erectus, virgatus, cinereo- vel fusco-tomentellus, ramosus; foliis trifoliolatis foliolis oblanceolatis vel oblongo-obovatis intermediis quam iis typi majoribus; calycis lobo antico longiore et angustiore.

Melsetter District, 6000 ft.; in fl. Sept.; n. 1417.

A small shrub with purple-tinted flowers, common in Northern Melsetter.

Caulis in specimine nostro saltem 33 cm. longus. Foliola 2·0–3·5 cm. longa. Petioli 1·0–2·0 mm. longi. Calycis tubus ± 3·0 mm. longus, lobi antici ±5 mm. longi. Vexillum 8·0–9·0 mm. longum. Alæ ±8 mm. longæ. Carina ± 7·5 mm. longa. Semina ± 3·5 mm. longa.

The type comes from the Leikipia Plateau, British East Africa.

INDIGOFERA PROCERA, *Schum. & Thonn. Beskr. Guin. Pl.* 365.

Chipetzana, 3000 ft.; in fr. April; n. 1485.

Distrib. Upper Guinea, Lower Guinea, Nyasaland.

I. HILARIS, *Ecklon & Zeyher, Enum.* 241.

Melsetter, 5000–6000 ft.; in fl. Oct.; n. 6187. Northern Melsetter, 5000–6000 ft.; in fl. Oct.; n. 6189. Near Chirinda, 3500 ft.; in fl. May; n. 477.

I. Wentzeliana, Harms, is either identical with this or very closely allied to it. *I. Nyassæ*, Harms, is also closely allied.

Distrib. South Africa, Natal, Transvaal, Nyasaland.

I. HEDYANTHA, *Ecklon & Zeyher, Enum.* 243.

Mt. Pene, 7000 ft.; in fl. Sept.; n. 2094. *I. Goetzei*, Harms, is closely allied to it.

Distrib. South Africa, mountains of Eastern Frontier, Transvaal, Nyasaland.

I. ENDECAPHYLLA, *Jacq. Ic. Rar.* t. 570.

Near Chirinda, 3800 ft.; in fr. April, n. 371; in fr. May, n. 480.

Distrib. Widely distributed.

I. sangana, Harms, is closely allied to this species.

I. EMARGINELLA, *Steudel, ex Rich. Tent. Fl. Abyss.* i. 184.

Chikore Hills, 3500 ft.; in fl. March; n. 1471.

Distrib. Nile Land.

I. ARRECTA, *Hochst. ex Rich. Tent. Fl. Abyss.* i. 184.

Chikore Hills, 3500 ft.; in fl. March; n. 266. Chindao name, "Mudotasikwi."

Very fragmentary, more material necessary to confirm this.

Distrib. Widely distributed in Africa.

I. CECILI, *N. E. Brown in Kew Bull.* 1906, 101.

Near Chirinda, 3800 ft.; in fl. & fr. Nov., n. 262; in fl. & fr. April, n. 263. A herb with pink flowers. Closely allied plants are n. 267 from Chikore Hills, and n. 1459 from Melsetter, 6000 ft.

Distrib. Inyanga Mts.

INDIGOFERA LYALLII, *Baker in Journ. Linn. Soc., Bot.* xx. (1883) 128.

Chimanimani Mts. at 7000 ft.; in fr. Sept.; n. 1458. A large shrub in crags.

Distrib. Madagascar, Nyasaland.

Other species of *Indigofera*, but too fragmentary for identification, are n. 1460 from Northern Melsetter, and n. 1486 from Chipetzana River at 3000 ft.

TEPHROSIA LONGIPES, *Meissner in Hook. Lond. Journ. Bot.* ii. (1843) 87.

Beira open woods, 50 ft.; in fl. Dec.; n. 1445.

Distrib. South Africa, Natal.

T. GRANDIFLORA, *Persoon, Syn.* ii. 329.

Chirinda, 3800 ft.; in fl. & fr. April; n. 369. A herb growing in short grass.

Distrib. South Africa, Natal.

T. PURPUREA, *Persoon, Syn.* ii. 329.

Chibabava, Lower Buzi, 400 ft.; in fr. Nov.; n. 1444.

Distrib. Widely distributed.

T. NYASÆ, *Baker fil. in Trans. Linn. Soc.* ser. 2, *Bot.* iv. (1894) 9.

Chimanimani Mts. at 7000 ft.; in fl. Sept.; n. 1464. A large shrub in the crags.

Distrib. Nyasaland.

MUNDULEA SUBEROSA, *Benth. in Miq. Pl. Jungh.* 248.

Beira open woods; in fr. Dec.; n. 1423. Sabi River, 1000 ft.; in fl.; n. 1453.

Distrib. Widely distributed in Africa. Also in India.

MILLETTIA STUHLMANNII, *Taub. in Engler, Pflanzenw. Ost-Afr.* C. (1895) 212.

Arbor parva. Cortex externus, sæpe papyraceus, aurantiacus. Ramuli et foliola primo pubescentes, mox glaberrimi. Alabastra lenticularia. Folia 20–30 cm.; foliola 7–9, ovali-obcordata, 9–10 cm. longa, chartacea, subtus pallida, basi obtusa vel rotundata, venis 7–10-jugis regularibus rectis, ascendentibus subtus prominentibus, stipellis magnis petiolulos sæpe æquantibus. Panicula terminalis, angusta, simplex, 20–35 cm. longa, rhachi ramisque superne pubescentibus. Flores in ramis 3–4 cm. longis secus rhachin laxe dispositis, ebracteolatis, singulatim racemose orti. Calyx campanulatus, pubescens, 12 mm. longus, lobis ovatis tandem reflexis, supremo 5 mm. longo emarginato, aliis 3 paullo minoribus, pedicello æquilongus; corolla 25 mm. longa, glabra, cærulea vel dilute purpurea; vexillum lingolatum, ovatum, basi cordatum, auriculatum, alæ et carina æquilongæ; stamina diadelphia; ovarium stipitatum, sericeum, 4–5-ovulatum. Legumen in specimine nostro deest.

Hab. Zona River, Jihu, 2000 ft. ; fl. Nov. ; n. 146. Lower Zona ; fl. Nov. ; n. 145. Kurumadzi, Jihu ; fl. Nov. ; n. 1396. Chibabava, Lower Buzi ; 400 ft. ; n. 1428. A tree with birch-like papery bark and purplish-blue flowers.

Mr. Dunn, to whom this plant was referred, was at first inclined to regard it as an undescribed species, but subsequently, after having seen material from the Berlin Herbarium, he considers it to be *M. Stuhlmannii*, and originally described from Mozambique. We have, however, included Mr. Dunn's description as the original account is somewhat meagre.

SCHEFFLERODENDRON GAZENSE, *E. G. Baker*, sp. nov. (Pl. 2. figs. 6–7.)

Arbor altissima (sec. cl. detectorem), foliis petiolatis imparipinnatis glabris vel subglabris eglandulosis, petiolo communi tenui, foliolis 5–7 brevissime petiolulatis alternis oblongis vel oblongo-oblanceolatis vel oblongo-ovatis apice acuminatis basi cuneatis vel rotundatis ; racemis multifloris laxis solitariis, rhachi ferrugineo-tomentosa angulata, bracteis brevibus squamiformibus, pedicellis tenuibus bracteis 3–5-plo longioribus, bracteolis ad basin calycis brevibus quam tubo calycis 3–3-plo brevioribus ; calyce ferrugineo-tomentoso dentibus 5 ; corolla calycem excedente, vexillo extus demum glabro carinæ subæquilongo, alis carinæ subæquilongis, carina basin unguiculata naviculariformi, ovario pauciovulato breviter stipitato præcipue basin versus strigoso-piloso lineari, stylo glabro ; legumine sublignoso glabro circiter 2-spermo.

Hab. Chirinda Forest, alt. 3700–4000 ft. ; n. 13. In fl. Oct. 1905.

Chindao name, "Mushamba." One of the largest forest trees, with ochraceous yellow bark and very hard, heavy, whitish timber. Flowers white, the centre of the vexillum green. Buds strongly tinged with pink. Beans probably poisonous.

Petiolus communis 5–7 cm. longus. Petioluli ± 3 mm. longi. Foliola (antica) 60–75 mm. longa, 20–30 mm. lata, (postica) 45–55 mm. longa, 20–25 mm. lata. Racemi 6–9 cm. longi. Pedicelli 6–8 mm. longi. Bracteæ ad basin pedicelli 2·5–3·0 mm. longæ. Bracteolæ ad basin calycis ± 2·5 mm. longæ. Calyx totus 6–7 mm. longus, tubus ±5 mm. longus, dentes ±2 mm. longi. Vexillum ±16–18 mm. longum. Alæ ±17–18 mm. longæ. Carina ± 16–17 mm. longa.

This plant is certainly congeneric with Scheffler no. 6, from Kibwesi, distributed from Berlin as *Schefflerodendron usambarense*, Harms. It differs from Dr. Harms's description of *Schefflerodendron* in being eglandular and in the ovary being shortly and broadly stipitate, but the leaflets are alternate and the pod is ± 2-seeded and dehisces. *Dalbergia brevicaudata*, Vatke, is also an ally, but the leaflets are broader.

In certain genera of Leguminosæ, as, for instance, *Crotalaria*, the ovary is sometimes sessile, sometimes more or less stipitate.

ÆSCHYNOMENE (Ochopodium) GAZENSIS, *E. G. Baker*, sp. nov.

Frutex ramosus, superne glandulosus; stipulis lanceolatis striatis basifixis cuspidatis petiolum 3–4-plo superantibus; foliis brevissime petiolatis, foliolis sæpissime 8–11-jugis parviusculis lineari-oblongis apice mucronatis glabris; racemis axillaribus laxis paucifloris, pedicellis gracilibus setuloso-glandulosis, floribus (sec. cl. detectorem) flavis mediocribus; bracteis parvis, prophyllis 2 ad pedicelli apicem insertis glabris oblongis acutis; calycis labio superiore glabro quam inferiore paullo breviore; vexillo calycem fere 2-plo superante ad basin unguiculato, alis oblongis basi unguiculatis, carina alis subæquante apice obtusa basi unguiculata; ovario biovulato glabro præter marginem posteriorem ciliato, stylo glabro tenui; legumine stipitato sæpissime bi-articulato rarius uniarticulato suturis superioribus incrassatis.

Hab. Melsetter District, 6000 ft., n. 1457. A shrub with yellow flowers. In flower Sept. 23. Nos. 252 & 1501 are allied plants.

Foliola ± 3·0 mm. longa, vix 1 mm. lata. Calycis labium superum ± 5 mm. longum, labium inferum ± 6 mm. longum. Vexillum ± 9 mm. longum. Alæ ± 10 mm. longæ. Carina ± 10 mm. longa.

Closely allied to *Æ. Ruppellii*, Baker; it differs from it by the shorter racemes, fewer flowers, and more or less tortuous and setulose-glandular pedicels; from *Æ. mimosifolia*, Vatke, it differs by the larger leaflets and larger flowers.

ÆSCHYNOMENE NODULOSA, *E. G. Baker*, nov. comb.

Smithia nodulosa, Baker in Oliver, Fl. Trop. Afr. ii. 153 (1871).

Æschynomene shirensis, Taubert, Pflanzenwelt Ost-Afr. C. 215 (1895).

Melsetter, Rhodesia, 6000 ft.; in fl. Sept.; n. 619. A shrub with orange-yellow flowers.

Distrib. Nyasaland.

Æ. GRANDISTIPULATA, *Harms in Fedde Rep. Sp. Nov.* viii. (1910) 355.

Chimanimani Mts., 7000 ft., n. 1499, and *W. Johnston*, n. 232.

Distrib. Chimanimani Mts.

A shrubby tree, 3 m. high, with very succulent foliage. Flowers orange with purple stripes.

SMITHIA (Kotschya) THYMODORA, *E. G. Baker*, sp. nov.

Frutex ramosus, præsertim superne hispido-viscosus (sec. cl. detectorem) odorem thymi spirans; stipulis oblique lanceolato-setaceis petiolo brevioribus; foliis ± recurvatis, rhachi subaculeata, foliis plerumque 12–15-jugis oblique lineari-oblongis subacutis costa valde excentrica margine ciliata; racemis axillaribus subcapitatis breviter pedunculatis undique aureo-hispidis; bracteis ovatis acutis vel subacuminatis, prophyllis 2 ad apicem pedicelli insertis lanceolatis; calycis labio superiore usque ad ¼ partito, labio inferiore ad vel ultra medium trifido omnibus subcoriaceis hispidis; corolla (sec. cl. detectorem) flava calycem paullo superante, vexillo suborbiculari basi ungui-

culato ; alis anguste oblongis carinam subæquilongis basi unguiculatis ; carina apice obtusa basi unguiculata naviculariformi quam vexillo paullo breviore ; ovario distincte stipitato pilis albidis tecto, stylo tenui gracili usque ad medium pilis ± tecto apice glabro ; legumine ignoto.

Hab. Melsetter District, 6000 ft. ; n. 655. A shrub with sticky thyme-scented foliage and yellow flowers.

Foliola 4·0–5·0 mm. longa, 1·0–1·5 mm. lata. Prophylla 3·0–3·5 mm. longa. Calycis labium superum ± 11 mm. longum, labium inferum ± 10 mm. longum. Vexillum ± 14 mm. longum. Alæ 13 mm. longæ. Carina 12–13 mm. longa.

Allied to *S. Harmsiana*, De Wild.; it differs from it by the smaller leaflets and more numerous flowers. From *S. uguenensis*, Taub., it differs by the shorter leaflets.

SMITHIA STRIGOSA, *Benth. in Miq. Pl. Jungh.* 211.

Near Chirinda, 3800 ft. ; in fl. April ; n. 264. Chipetzana River, 3000 ft.; in fl. April; n. 1483. Mt. Pene, 7000 ft.; in fl. Oct.; n. 6180.

Distrib. Benguella, Nyasaland, Congo Region ; also Madagascar.

ERYTHRINA HUMEANA, *Spreng. Syst.* iii. 243.

Near Chirinda, 3500 ft. ; in fr. June; n. 603. Mt. Maruma, 3500 ft. ; in fl. Sept. ; n. 1470. A tree up to 80 ft. in height, thorny. Chindao name, "Murungu."

Distrib. Mozambique District, South Africa.

E. TOMENTOSA, *R. Br. in Salt Abyss. App.* 65 (nomen) ; *A. Rich. Tent. Fl. Abyss.* i. 213.

Melsetter District ; in fl. & young fr., Sept., n. 154 ; in fl. Oct., n. 668. A small tree with rough furrowed bark. A spreading head of leathery leaves, thorns and red flowers, deciduous. Chindao name, "Gombati" ; Dutch, "Kafir Boom."

Distrib. Widely distributed in Africa.

MUCUNA CORIACEA, *Baker in Oliver, Fl. Trop. Afr.* ii. 187.

Near Chirinda, 3500 ft.; in fl. May ; n. 450. Chipetzana River, 3000 ft. ; in fl. April ; n. 1487. Nyahodi River, 5000 ft. ; in fl. April ; n. 1488. Chindao name, "Oriri." "Brant-bontje" of the South African Dutch. "Buffalo-bean" of local colonists.

Distrib. Mozambique District.

VIGNA HIRTA, *Hook. Ic. Pl.* t. 637.

Near Chirinda, 3800 ft. ; in fl. April ; n. 363. Umvumvumvu River at 4000 ft. ; in fl. Oct.; n. 6191.

Distrib. Transvaal.

VIGNA LUTEOLA, *Benth. in Mart. Fl. Bras.* xv. i. 194, t. 50. f. 2.
Chimanimani Mts., 7000 ft.; in fl. Sept.; n. 1467. Mt. Pene, 7000 ft.; in fl. Oct.; n. 6192.
Distrib. Widely distributed.

SPHENOSTYLIS MARGINATA, *E. Meyer, Com. Pl. Afr. Austr.* 148.
Chirinda, 3800 ft.; in fl. April; n. 364. Southern Melsetter, 3500 ft.; in fl. Oct.; n. 6624.
Dolichos erectus, Bak. fil. in Trans. Linn. Soc. ser. II. iii. (1894) 10, from Nyasaland, is perhaps indistinguishable from the above.
Distrib. South Africa, Nyasaland, Rhodesia.

DOLICHOS LUPINIFLORUS, *N. E. Brown in Kew Bull.* 1906, 102.
Near Chirinda, 3500 ft.; in fl. Nov.; n. 1045. A tall herb or shrublet with bright purple flowers and swollen roots. "Bully beef plant," in allusion to the lean and fat appearance of the cut roots.
Distrib. The type was collected by Mrs. Evelyn Cecil, n. 23, between Beira and Massi Kessi.

D. BRACHYPUS, *Harms in Engler Jahrb.* xxvi. (1899) 323.
Jihu, near Upper Chinyika; in fl. Nov.; n. 368. A large shrub with purple flowers common in parts of Jihu. Also probably on the Lower Umswirizwi, 1000 ft.; in fr. Nov.; n. 1046. A small shrub with bluish-purple flowers and very large tuberous roots, which are pounded up and thrown into ponds to kill fish. Chindao name, "Idema."
Distrib. Koomati Poort. The above specimens differ from type in having longer petioles.

RHYNCHOSIA CYANOSPERMA, *Benth. ex Baker in Fl. Trop. Afr.* ii. 218.
Chikore Hills, 3500 ft.; in fl. Feb.; n. 226.
Distrib. Mozambique District. Also India.

R. ORTHODANUM, *Benth. ex Harv. & Sond. Fl. Cap.* ii. 257.
Near Chipete Forest Patch, 3800 ft.; in fl. Oct.; n. 1500. A small shrub with yellow flowers.
Distrib. South Africa.

R. CLIVORUM, *S. Moore in Journ. Bot.* xvi. (1878) 131.
Chimanimani Mts., 7000 ft.; in fl. Sept.; n. 1461. Mt. Pene, 7000 ft; n. 6184.
A somewhat large shrub common in forest outskirts. *R. pycnantha*, Harms, is apparently synonymous. *Flemingia macrocalyx*, Bak. fil., is allied to it, but has smaller flowers and a subinflated pod.
Distrib. Transvaal, Nyasaland.

RHYNCHOSIA FLAVISSIMA, *Hochst. ex Baker in Oliver, Fl. Trop. Afr.* ii. 219.
Chirinda outskirts, 3700–4000 ft.; in fl. Oct.; n. 448.
Distrib. Widely distributed in Tropical Africa.

R. MONOPHYLLA, *Schlechter in Journ. Bot.* xxxv. (1897) 297, non *Torrey & Gray*.
Chirinda, 3800 ft.; in fl. Feb.; n. 390, also n. 451. Chirinda Forest, 3700–4000 ft.; leaves only; n. 1162. Melsetter, 6000 ft.; n. 6190. Mt. Pene, 6500–7000 ft.; in fl. Sept.; n. 1466. A trailing plant with yellow flowers.
Distrib. Transvaal.

ERIOSEMA SHIRENSE, *Bak. fil. in Trans. Linn. Soc.* ser. 2, *Bot.* iv. (1894) 11.
Lusitu Hills, 5000 ft.; in fl. April; n. 1497.
Distrib. Nyasaland.

E. MONTANUM, *Bak. fil. in Journ. Bot.* xxxiii. (1895) 142.
Near Chirinda, 3800 ft.; in fl. April; n. 361. Not the typical form of this species.
Distrib. German East Africa, Nyasaland.

E. ELLIPTICUM, *Welw. ex Baker in Oliver, Fl. Trop. Afr.* ii. 227.
Melsetter, 6000 ft.; in fl. Sept.; n. 624.
I am unable to separate from this *Millettia monophylla*, Harms, in Engler, Jahrb. xxvi. 270.
Distrib. Angola, Nyasaland.

FLEMINGIA RHODOCARPA, *Baker in Oliver, Fl. Trop. Afr.* ii. 231.
Chirinda outskirts, 3700–4000 ft.; in fl. July; n. 1048. A shrub with pale greenish flowers.
Distrib. Mozambique Distr., Nyasaland, Rhodesia, Natal, Transvaal.

PTEROCARPUS ANGOLENSIS, *DC. Prodr.* ii. 419.
Open woods, Chirinda, 3300 ft.; in fl. Oct.; n. 41. Nyahodi River, 5000 ft.; n. 1439. A small to medium-sized tree of open woods. Chindao name, "Muhwangazi."
Distrib. Angola, Rhodesia.

P. SERICEUS, *Benth. in Journ. Linn. Soc., Bot.* iv. *Suppl.* (1860) 75.
Chirinda, 3500 ft.; in fl. Jan.; n. 28. A medium-sized tree with bright yellow flowers and rough bark. Chindao name, "Mumbhungu"; local Dutch, "Blink-blaarboom."
Distrib. Rhodesia.

Pterocarpus abyssinicus, *Hochst. ex Rich. Tent. Fl. Abyss.* i. 233.

Boka, Lower Buzi, 400 ft.; in fl. Dec.; n. 1432. A small tree on limestone.

Distrib. Nile Land.

Lonchocarpus violaceus, *Oliver in Trans. Linn. Soc.* xxix. (1872) 62.

Capassa violacea, Klotzsch in Peters Mossamb. Bot. 28. t. v.

Chibabava, Lower Buzi, 400 ft.; in fr. Dec.; n. 592. A small tree of the open woods. Sabi River at about 1000 ft.; in young fr. Nov.; n. 1451. A fair-sized tree with white or bluish-white flowers. Chindao name, "Umpanda." Sabi River, at about 1000 ft., n. 1397, may also belong here.

Dr. Harms places it in the genus *Derris* (conf. Engler, Jahrb. xxxiii. 174).

Distrib. Mozambique District.

Bolusanthus speciosus, *Harms in Fedde, Rep. Nov. Sp.* ii. 15 (1906).

Lonchocarpus speciosus, Bolus in Journ. Linn. Soc. xxv. (1887) 161.

Umvumvumvu River, 4000 ft.; in fl. Oct.; n. 6167. A small to medium-sized tree with masses of handsome Wistaria-like flowers.

Distrib. Rhodesia, Delagoa Bay.

Dalbergia Swynnertonii, *E. G. Baker*, sp. nov.

Frutex vel arbuscula, ramulis striatulis; foliis petiolatis imparipinnatis sæpe 5-jugis, foliolis ellipticis vel ovato-oblongis suboppositis vel alternis junioribus rufo- vel fusco-subtomentosis, costa superne impressa, nervis lateralibus tenuibus subtus prominulis erecto-patentibus, foliolorum petiolo brevi rufo- vel ferrugineo-pubescente quam lamina multoties breviore rhachi rufo- vel ferrugineo-pubescente; paniculis axillaribus quam foliis brevioribu splurivel multifloris pedunculis pedicellisque ferrugineo- vel fusco-subtomentosis; bracteolis 2 oppositis apicem pedicellorum versus dispositis angustis; calyce extus ferrugineo-pubescente dentibus quam tubo brevioribus 2 superioribus quam aliis paullo majoribus triangularibus; vexillo apice emarginato carinam superante; alis oblongis basi graciliter et tenuiter unguiculatis; carina basi unguiculata; staminibus in 2 phalanges dispositis; ovario distincte stipitato pubescente, stylo glabro; legumine juniore rufo vel ferrugineo sericeo-tomentoso plano oblongo.

Hab. Nyahodi River at about 4000 ft.; in fl. Sept.; no. 1316. Inyamadzi Valley, 2700 ft.; in fl. Oct.; no. 1317.

A large shrub or small tree with white sweet-scented flowers, growing chiefly on schist, said to be infested by edible saturniad caterpillars at the time of the ripening of the seeds. Chindao name, "Mupezana."

Folia 8·0–12·0 cm. longa. Foliola 3·5–4·5 cm. longa, 13–16 mm. lata, foliolorum petioluli ± 3 mm. longi. Calyx ± 7 mm. longus. Vexillum ± 1 cm. longum. Alæ cum unguibus ± 8 mm. longæ. Carina ± 8 mm. longa.

Differs from *D. Dekindtiana*, Harms, by the smaller leaflets and narrower wings of the flower.

DALBERGIA MELANOXYLON, *Guill. & Perr. Fl. Seneg. Tent.* i. 227.

Lower Umswirizwi River, 1000 ft.; in fl. Oct.; n. 177. A large shrub with white flowers. Sabi River at about 1000 ft.; in fl. Nov.; n. 2093. Chibabava, Lower Buzi, 400 ft. Chindao name, "Murgwiti."

Distrib. Widely distributed.

D. LACTEA, *Vatke in Oest. Bot. Zeit.* xxiv. (1879) 251.

Mt. Maruma, 3500 ft.; in fl. Oct.; n. 1469. Lusitu River, 3000 ft.; in fl. Sept.; n. 1468.

Distrib. German East Africa, Nyasaland.

There is another species of *Dalbergia*, n. 1201 from the Sabi River. It may be *D arbutifolia*, Baker, but flowers are required for identification.

CALPURNIA LASIOGYNE, *E. Meyer, Com. Pl. Afr. Austr.* 3.

Chirinda outskirts, 3700–4000 ft.; in fl. May; n. 79. A small tree with bright yellow flowers and somewhat rough bark.

Distrib. South Africa, Angola, Nile Land, Mozambique District.

SOPHORA ? ZAMBESIANA, *Baker in Oliver, Fl. Trop. Afr.* ii. 253.

Sabi River, at about 1000 ft.; in fl. Nov.; n. 1452. A large tree with white flowers. Chindao name, "Mutsha."

Distrib. Mozambique District.

ORMOSIA ANGOLENSIS, *Baker in Oliver, Fl. Trop. Afr.* ii. 255.

Jihu-Zona-Kurumadzi Watershed, 2300 ft.; in fl. & fr. Nov.; n. 29. Kurumadzi Valley, 2000 ft.; in fl. Nov.; n. 1338. Chikambogé Valley, 3000 ft.; in fr. Sept.; n. 1339. Chikore Hills, 3500 ft.; in fr. March; n. 1473. Chindao name, "Chianga" or "Chiwhanga." Harms proposes the genus *Afrormosia* for this plant.

Distrib. Angola.

PELTOPHORUM AFRICANUM, *Sond. in Linnæa*, xxiii. (1850) 35.

Inyamadzi Valley, 3300 ft.; in fl. Dec.; n. 156. Near Chirinda, 3500 ft.; in fr. Jan.; n. 1020. Muchukwana, Lower Buzi, 100 ft.; in fl. Dec.; n. 1022. A large broad-crowned shrub with yellow flowers.

Distrib. South Africa, Rhodesia, Angola, Kunene, Zambesi Region.

PTEROLOBIUM LACERANS, *R. Br. in Salt Abyss., App.* 64.

North Melsetter, 2000–6000 ft.; in fr. April; n. 1044. Chindao name, "Igado."

Distrib. Widely distributed.

Cassia abbreviata, *Oliver in Fl. Trop. Afr.* ii. 271.

Chinyika River, Jihu, 2000 ft.; in fl. Nov.; n. 147. Also probably Chikore Hills, 3500 ft.; in fl. Nov.; n. 1472.

Distrib. Mozambique District.

C. Petersiana, *Bolle in Peters Mossamb. Bot.* 13.

Melsetter District, 3700 ft. ; in fl. April ; n. 199 ; 6000 ft. ; in fl. Sept.; n. 673. Umvumvumvu Mts., 4000 ft. ; in fl. April; n. 1155. Chindao name, " Murembarembe."

Distrib. Nile Land, Mozambique Distr., Nyasaland. Also in Madagascar.

C. didymobotrya, *Fres. in Flora*, xxii. (1839) 53.

Inyamadzi Valley, 2500 ft.; in fl. Sept.; n. 1434. Near Chirinda, 3500 ft. ; in fl. June ; n. 1419. A tall soft-wooded shrub, with yellow flowers greatly appreciated by small brown ants.

Distrib. Widely distributed in Tropical Africa.

Bauhinia fassoglensis, *Kotschy, ex Schweinf. Reliq. Kotsch.* (1868) 14, t. 12.

Foot of Mt. Singuno, 1200 ft.; in fl. Nov. ; n. 1252. A trailing shrub with light gamboge flowers. Noted also in the Madanda Forest at Ancate.

Distrib. Widely distributed.

B. Petersiana, *Bolle in Peters Mossamb. Bot.* 24.

Umhlonhlo, Lower Buzi, 100 ft. ; in fl. Jan. ; n. 1253.

Distrib. Mozambique District.

B. Galpini, *N. E. Brown in Hook. Ic. Plant.* (1891) t. 1994.

Open woods near Chirinda, 3500 ft.; in fl. Dec.; n. 192. Umtefu, Lower Buzi, 1000 ft.; in bud Jan. ; n. 1251. Kurumadzi R., Jihu, 2000 ft.; in fl. Nov. ; n. 1249. A large trailing shrub with red flowers. Chindao name, " Chigwedere."

Distrib. Transvaal, Beira.

B. reticulata, *DC. Leg. Mem.* xiii. 484.

Near Chirinda, 3600 ft. ; in bud, March ; n. 165. Zinzumbo Hills, 1500 ft.; in bud, Jan. ; n. 1255. Chindao name, " Umsetuzi."

Distrib. Widely distributed.

Pahudia quangensis, *Prain in Sci. Mem. Med. Off. Ind.* xii. 16.

Mt. Singuno, 1400 ft. ; in fl. Oct.; n. 57. Lusitu River at about 2500 ft.; in bud, Sept. ; n. 1447. Chindao name, " Musokosa."

Distrib. Widely distributed.

BRACHYSTEGIA GLOBIFLORA, *Hook. Ic. Plant.* sub t. 1359.

Common throughout Melsetter; in fl. March; n. 164. Near Chirinda, 3800 ft.; in fl. Jan.; n. 6586. Native name, "Mutondo." A small to medium-sized tree.

Distrib. Nyasaland, Rhodesia.

B. BRAGAEI, *Harms in Engler Jahrb.* xxx. (1901) 82.

Melsetter District, 5000 ft.; in fl. Sept.; n. 657. Native name, "Mutsatsa." A small to medium-sized tree with handsome young foliage.

Distrib. Beira.

B. SPICÆFORMIS, *Benth. in Trans. Linn. Soc.* xxv. (1866) 312.

Inyamadzi River, 2000 ft.; in fl. Sept.; n. 1024.

Distrib. Lower Guinea, Mozambique District.

Mr. Sim (Forest Flora Portug. E. Afr.) describes two new species, *B. oblonga* and *B. pectinata*. The following short clavis indicates the difference between *B. spicæformis* and *B. Bragaei*. The genus *Brachystegia* has not been recorded for Natal.

A. Folia sæpissime 4–6-juga. Bracteolæ obovatæ. Sepala 2. Tubus stamineus usque ad 1·5–2·0 mm. longus.
B. spicæformis, Benth.

B. Folia sæpissime 5–7-juga. Bracteolæ oblongo-obovatæ. Sepalum unicum tantum evolutum, minutum. Tubus stamineus usque ad 1·0 mm. longus.
B. Bragaei, Harms.

COPAIFERA MOPANE, *Kirk, ex Benth. in Trans. Linn. Soc.* xxv. (1866) 317.

Muchukwana, Lower Buzi, 400 ft.; collected Jan.; n. 1250.

Distrib. Lower Guinea, Mozambique Distr., Kunene-Zambesi Region, Rhodesia, Hereroland.

ENTADA ABYSSINICA, *Steud. ex Rich. Fl. Abyss.* i. 234.

Chinyika R., Jihu, 2000 ft.; in fl. Nov., n. 149; in fl. Nov., n. 1051. A large wide-branching shrub. Pod required to confirm identification. Also probably Lower Umswirizwi, 1000 ft., n. 1247, but pod required for identification.

Distrib. Nile Land, Lower Guinea.

PIPTADENIA BUCHANANI, *Baker in Kew Bull.* 1894, 354.

Upper Buzi in wooded glen, 3500 ft.; in fl. Oct.; n. 1018. A large tree.

Distrib. Nyasaland.

The following also are forms of this species: n. 1017 from Mt. Maruma, and n. 7 from Chirinda Forest.

DICHROSTACHYS NUTANS, *Benth. in Hook. Journ. Bot.* iv. (1842) 353.

Chirinda open woods, 3500 ft, ; in fl. Oct.; n. 162. Chikore Hills, 3500 ft. ; in fl. Nov. ; n. 1015. Chirinda, 2000 ft. ; in fl. Dec. ; n. 1013. Southern Melsetter, 2000–3500 ft. ; in fl. Nov. n. 1016. Madanda Forest at 400 ft. ; in fl. Dec., n. 1012 ; in fl. Dec., n. 1014. Lusitu River, n. 1019.

Distrib. Widely distributed.

The following have smaller leaflets, and are closely allied to *D. cinerea*, Wight & Arn. : n. 1010, from Chibabava, and n. 1011, from Chironda. *D. major*, Sim, is said to be frequent in the thorn veld of Lourenço Marques to the Lebombes, but has broader pods. Unfortunately, Mr. Swynnerton's specimens are only in flower.

ACACIA CAFFRA, *Willd. Sp. Pl.* iv. 1078.

Chikambogé Valley, 3000 ft. ; in fl. Dec. ; n. 61. A common large thorn-tree with white flowers. Kurumadzi, 2000 ft. ; in fl. Nov. ; n. 61 *a*. Hode, Lower Buzi, 400 ft. ; in fl. Dec. ; n. 1243. A large thorn-tree. Kurumadzi, Jihu, 2000 ft. ; n. 1242. Chindao name, "Iguwha."

Distrib. Lower Guinea, South Central Region. Common in some parts of South extratropical Africa.

A. PENNATA, *Willd. Sp. Pl.* iv. 1090.

Chirinda Forest, 3700–4000 ft. ; in fl. Jan. ; n. 84. Madanda Forest at about 4000 ft. ; in fl. Dec. ; n. 1244. A large woody thorny climber. Chindao name, "Igado."

Distrib. Widely distributed.

A. HORRIDA, *Willd. Sp. Pl.* iv. 1082.

Umvumvumvu R., 2000 ft. ; coll. April ; n. 59 *a*. A small tree.

Distrib. Cape Colony, Natal, Transvaal.

Flowers and pods required. There are several other specimens of *Acacia*, but pods are required for identification.

ALBIZZIA HARVEYI, *Fournier in Bull. Soc. Bot. Fr.* xii. (1865) 399.

A. hypoleuca, Oliver in Fl. Trop. Afr. ii. 356.

A. Pospischilii, Harms in Notizbl. Bot. Gart. Berl. i. (1896) 183.

Lower Umswirizwi, 1000 ft.; in fl. Nov. ; n. 144. Sabi River, 1000 ft. ; in bud, Nov. ; n. 1216. Umtefu, Lower Buzi, 600 ft., n. 1043, is a form with leaflets not so white below as in the type ; it agrees with *Busse*, n. 717. A small tree with creamy-white flowers.

Distrib. South Central Region, Mozambique District

ALBIZZIA ANTHELMINTICA, *Brongn. in Bull. Soc. Bot. Fr.* vii. (1860) 902.
Sabi R., 1000 ft. ; in fr. Nov. ; n. 1005. A fairly large tree.
Distrib. Widely distributed.

A. VERSICOLOR, *Welw. ex Oliver, Fl. Trop. Afr.* ii. 359.
Var. MOSSAMBICENSIS, *Schinz in Bull. Herb. Boiss.* sér. 2, ii. (1902) 946.
Jihu, Lower Zona River, 2000 ft. ; in fl. Nov. ; n. 51.
Distrib. of var. Mozambique District. *A. mossambicensis*, Sim, is closely allied.

A. ANTUNESIANA, *Harms in Engler Jahrb.* xxx. (1901) 75.
Jihu, Lower Zona, 2300 ft. ; in fl. Nov. ; n. 51. A fairly large tree, common. Chindao name, "Mubvangazi." Chirinda open woods, 3500 ft. ; in fl. Oct. ; n. 53. A small tree of the open woods. (Verified at Berlin.)
Distrib. Mozambique District.

A. FASTIGIATA, *Oliver in Fl. Trop. Afr.* ii. 361.
Var. NOV. CHIRINDENSIS, *Swynnerton.*
Arbor parva vel mediocris, ramis adultis glabris ramulis novellis ferrugineo-tomentosis ; foliis 5–12-jugis sessilibus rhombeo-oblongis ; calycis tubo quam in typo distincte longiore ; corollæ tubo calyce fere duplo longiore ; ovario glabro ovulis ± 6.
Hab. Chirinda Forest, 3700–4000 ft. ; in fl. Oct. ; n. 52.
Arbor 10–15 m. alta. Folia 12·5–14·0 mm. longa. Foliola 8·0–14·0 mm. longa. Calyx ±6·0 mm. longus. Corolla ± 10·0 mm., lobi 2·0–3 mm. longi.
A smallish tree with dark rough bark and white flowers, differing from the type of *A. fastigiata*, Oliver, from Natal, in longer calyx, the longer corolla-tube, and in growth.
"Common on the western slopes of Mt. Mpengo and in the glens of the Mafusi District, and on the outskirts and glens of Chirinda and Maruma. The wood burns badly but splits easily, and is therefore a favourite with the natives for the doors and floors of their huts, but it is readily attacked by Bostrychidæ. Noted too in Inyamadzi Valley and on the ascent from the Buzi to Mount Umtereni itself. In glens at Maruma just commencing to come into leaf on Sept. 13th. Occurs in dense scrub of Chikambogé Valley, and on Kurumadzi in dense bush, where I found some good-sized specimens without flowers or fruit. Occurs in Madanda forests and open bush near Beira. Flowers just out on Chirinda outskirts Oct. 10th, 1905. This is very different in appearance from the low flat-topped spreading type of *A. fastigiata*, which I had the opportunity of inspecting in Durban and Delagoa Bay. It grows up with a straight clean trunk or trunks to a height of 30 or 40 feet, but seldom attains any considerable girth. It is far less

spreading than the type, and the bark, rough, blackish and deeply furrowed vertically, is absolutely different."

N. 54, from the Chirinda Forest, Chindao name, "Mundjeranshe," is a fairly large tree. It is a form of *A. fastigiata*, Oliver.

ROSACEÆ.

PARINARIUM CURATELLÆFOLIUM, *Planch. ex Benth. in Hook. Niger Fl.* 333.

Chikore Hills, 3500 ft.; in bud Nov.; n. 30. A fair-sized tree with large edible fruits. Chindao name, "Moura" or "Mumbhuni"; Mashona name, "Mushagata," "Sand Apple" or "Cork-tree." "Grys Appel" of Settlers.

Lower Jihu, 2000 ft.; in bud; n. 2076. Beira, Buzi mouth; in bud, Dec.; n. 302; Chirinda, open veldt, 3700 ft.; n. 306.

Mr. Sim records *P. Mobola*, Oliver, as the only species occurring in Portuguese East Africa.

N. 30 from the Haroni River has a more condensed inflorescence.

Distrib. Upper Guinea, Mozambique District.

P. GILLETII, *De Wild. in Ann. Mus. Congo*, ser. 5, i. 245.

Near Chirinda; in fl. Oct. n. 555, and in fl. Oct., n. 1303. A fairly large tree with greenish-white flowers, which have a slight but rather objectionable scent. In a wooded glen.

Distrib. Congo Region.

PYGEUM AFRICANUM, *Hook. fil. in Journ. Linn. Soc., Bot.* vii. (1864) 191.

Chipete Forest Patch, 4000 ft.; in fl. April; n. 1344. A very large tree in flower 14th April, with rough bark and red wood.

Chirinda outskirts, 3700–4000 ft.; in fl. April; n. 107. A small tree with whitish flowers and rough bark and red timber.

Distrib. Widely distributed in Tropical Africa. Also recorded from Zululand.

RUBUS MUNDTII, *Cham. & Schlecht. in Linnæa*, ii. (1827) 18.

Melsetter, Rhodesia; in fl. Sept.; n. 2077. A trailing shrub with pink flowers.

Distrib. South Africa.

R. RIGIDUS, *Sm. in Rees Cyclop.* xxx. no. 5, *non E. Mercier.*

Kloof near Chirinda; in fl. May; n. 454. A trailing bramble, fruit and flowers pink.

Distrib. South Africa, Angola.

LEUCOSIDEA SERICEA, *Ecklon & Zeyher, Enum.* 265.

Near Melsetter, 6000 ft.; in fl. Sept.; n. 605. A large shrub with rough bark.

Distrib. South Africa.

Cliffortia linearifolia, *Ecklon & Zeyher, Enum.* 270.

Melsetter, Rhodesia, 6000 ft.; n. 2078. A herb forming thickets along streams with minute white flowers.

Distrib. South Africa, Angola, Nyasaland.

SAXIFRAGEÆ.

Choristylis shirensis, *Bak. fil. in Trans. Linn. Soc.* ser. 2, iv. (1874) 13 *.

Melsetter, 6000 ft.: in fl. Sept.; n. 607. Kloof near Chirinda, 3800 ft.; nn. 202 & 203. Mt. Maruma, 3500 ft., in fl. Sept.; n. 2079. Mt. Pene, 7000 ft., in fl. Oct.; n. 6202.

Distrib. Nyasaland.

RHIZOPHOREÆ.

Weihea Gerrardi, *Schinz in Bull. Herb. Boiss.* v. (1897) 867.

Mt. Pene Forest, 6500–7000 ft.; in fl. Sept.; n. 1325. A medium-sized tree.

Distrib. Natal.

COMBRETACEÆ.

Combretum imberbe, *Wawra in Sitzungsb. Akad. Wiss. Wien, math.-naturw. Kl.* xxxviii. (1860) 557.

Boka to Omhlonhlo, Lower Buzi, 100 ft.; in fl. Dec.; n. 2080. A large shrub or small tree.

Distrib. Angola, Mozambique District.

C. erythrophyllum, *Sond. in Harv. & Sond. Fl. Cap.* ii. 509, pro parte.

Nyahodi River, 5500 ft.; in fl. Sept.; n. 701. A large tree with smooth white bark.

Distrib. Transvaal.

C. rhodesicum, *Bak. fil. in Journ. Bot.* xxxvii. (1899) 435.

Fifteen miles south of Umtali, Melsetter, 2000–3000 ft.; in fl. Oct.; n. 6600. A medium-sized shrub.

Distrib. Rhodesia.

C. arbuscula, *Engler & Gilg in Baum. Kunene-Sambesi Exped.* 314.

Chirinda open woods, 3700 ft., in fl. Oct.; n. 43. Chindao name, "Mukomahamba." A small tree with yellow flowers.

Inyamadzi Valley; in fr. April; n. 43 *a*. A fair-sized tree with yellow flowers, somewhat rough bark, and useless timber.

Distrib. Kunene-Zambesi Region.

* I know nothing of the species cited as *C. virescens*, Bak. fil., in Index Kewensis, Suppl. i. 95.

COMBRETUM APICULATUM, *Sond. in Linnæa*, xxiiii. (1850) 45.
Sabi River at about 1000 ft.; in fl. Nov.; n. 700. A tree as large as *Uapaca Kirkiana*, with white flowers and dark green foliage.
Distrib. Zambesi Region, Transvaal, Kunene Region, Damara-Namaqua Region, Kalahari.

C. SULUENSE, *Engler & Diels, Kunene-Sambesi Exped.* 54, ex descript.
Umswirizwi Flats, 1100 ft.; in fl. Nov.; n. 45. A small tree.
Distrib. Swaziland.

COMBRETUM (Glabripetalæ) GAZENSE, *Swynnerton & Bak. fil.*, sp. nov.
Arbor parva, ramis cortice cinereo-brunneo tectis; foliis sæpissime oppositis vel suboppositis majusculis, petiolo brevi cinereo-pubescente, lamina elliptica vel ovato-oblonga basi rotundata apice rotundata vel breviter mucronata adulta subcoriacea superne glabra et subnitida subtus breviter cinereo-tomentosa nervis lateralibus utrinque 8–12 arcuatim adscendentibus secundariis primarios conjungentibus; inflorescentia paniculata ramosa e spicis composita, bracteis parvis cinereo-tomentosis; floribus tetrameris; receptaculo inferiore elongato-conoideo extus cinereo-pubescente superiore infundibuliformi-campaniformi; disco insigni cupuliformi margine longe piloso; calycis segmentis æquilateraliter triangularibus apice acutis; petalis unguiculatis glabris obreniformibus flavis; staminibus quam stylo longioribus; fructu ignoto.
Hab. Mt. Umterene, 3000 ft., south slopes, n. 517. In fl. Sept. 8th, 1906. Between Buzi and Mt. Umterene, n. 688.
Arbor ±10 m. alta. Folia 11 cm.–15·0 cm. longa, 6·0–8·7 cm. lata; foliorum petiolus 8·0–18·0 mm. longus. Receptaculum inferius 3·5–4·5 mm. longum, superius ±4·5 mm. longum. Petala ±2·0–2·5 mm. longa et lata.
Allied to *C. Passargei*, Engler & Diels. It differs in the longer petioles, longer leaves, and longer lower receptacle and longer petals.

C. ZEYHERI, *Sond. in Linnæa*, xxiii. (1850) 46.
Umvumvumvu River, 2000 ft.; in fl. April; n. 2081. A small tree.
Distrib. Transvaal.
C. Bragæ, Engler, is a close ally of this species.

C. PORPHYROLEPIS, *Engler & Diels, Mon.* 63.
Boka, Lower Buzi, 100 ft.; in fl. Dec.; n. 2082. A large shrub on limestone.
Distrib. Transvaal, Koomati Poort.

C. BORUMENSE, *Engler & Diels, Mon.* 64, ex descript.
Madanda Forest, 400 ft.; in fl. Dec.; n. 599. A tree growing on ant-heaps at Arucate.
Distrib. Boruma.

COMBRETUM MICROPHYLLUM, *Klotzsch in Peters Mossamb. Bot.* i. 74.

Sabi River at about 1000 ft.; in fl. Nov.; n. 2083. A woody climber. Flowers bright red, sucked by the natives for the honey they contain. Madanda Forest at about 400 ft.; in fl. Dec.; n. 589.

Distrib. Nyasaland, Zambesi Region, Zulu-Natal Region.

C. ABBREVIATUM, *Engler in Pflanzenwelt Ost-Afr.* C. 292.

Chirinda Forest; in fl. Oct.; n. 95. A red-flowered climbing-plant on the outskirts of forest patches. Mt. Maruma, 3500 ft.; in fl. Sept.; n. 95 *a*. A large woody climber with scarlet stamens and anthers and pink and apple-green fruits.

Distrib. Mozambique District.

C. MOSSAMBICENSE, *Engler in Pflanzenwelt Ost-Afr.* C. 292. (*Poivrea mossambicensis*, Klotzsch.)

Sabi River at about 1000 ft.; in fl. Nov., n. 590; and in fruit, n. 591. A woody climber with conspicuous white flowers.

Distrib. Nyasaland, Zambesi Region.

TERMINALIA GAZENSIS, *E. G. Baker*, sp. nov.

Arbor parva, ramis cortice cinereo tectis novellis tomentellis; foliis apicem versus ramorum subaggregatis, petiolo mediocri cinereo-tomentello, lamina subcoriacea obovata vel oblongo-obovata basin versus cuneatim angustata apice rotundata vel subacuta supra primum sparse hirsuta demum præter costam sericeo-hirsutam subglabra subtus pallidiore nervis lateralibus utrinque 5–7 subtus prominentibus nervis secundariis tenuibus primarios conjungentibus; spicis laxifloris quam foliis brevioribus cinereo-pubescentibus; receptaculo extus glabro inferiore fusiformi superiore late patelliformi, disco inconspicuo longissime barbato; calycis segmentis triangularibus; stylo subconico cum staminibus haud exsertis; fructu ignoto.

Hab. Zinyumbo Hills, 1500 ft.; n. 152 *a*. In fl. January. A small tree with yellow flowers common throughout the open veldt of the lowlands.

Arbor ad 10 m. attingens. Foliorum petiolus 10–27 mm. longus; lamina 7·5–11·0 cm. longa, 2·5–5·0 cm. lata. Spicæ sæpe circ. 6·5 cm. longæ. Receptaculum inferius $\pm$3·5–5·0 mm., superius $\pm$3·5 mm. longum.

Allied to *T. Brownii*, Fres. It differs from it in the smaller flowers and the stamens scarcely exceeding the calyx, and from *T. obovata*, Sims, in the conspicuously longer petioles.

There are several specimens of *Terminalia* in the collection unfortunately not in fruit. N. 1107 from the Zinyumbo Hills is a tree with yellow flowers common throughout the open veldt of the country. It is apparently allied to *T. glaucescens*, Planch. N. 152 from Lower Umswirizwi River is closely allied to *T. Brownii*, Fres., from Abyssinia. Also n. 596 from Mt. Singuno,

and n. 596 *a* from Kurumadzi R., Jihu. Fruiting specimens are necessary for the identification of the above.

TERMINALIA SERICEA, *Burch. Cat. Geogr. Afr. Aust.* no. 2399.

Chibabava, Lower Buzi, 400 ft.; in fl. Nov.; n. 593. A small tree. Chindao name, "Mususu." Lower Umswirizwi, 1000 ft.; in fl. Nov.; n. 32. A small tree with durable timber and a bark with curious netted appearance.

The following is closely allied to var. ANGOLENSIS. Inyamadzi Valley, 2500 ft.; in fr. Sept.; n. 588. A small tree with fibrous-looking netted bark and durable timber.

Distrib. South Africa, Kunene-Zambesi Region, Angola, German East Africa, Nyasaland.

PTELEOPSIS MYRTIFOLIA, *Engler & Diels, Mon.* 4. (*Combretum myrtifolium*, Laws.)

Upper Inyamadzi; in fl. Dec.; n. 48. Inyamadzi Valley, 3300 ft.; in fr. April; n. 2084. A small to moderate-sized tree of the open woods. Flowers white, wood dark and rather rough. Timber fairly durable. Chindao name, "Musunganyemba."

Distrib. Mozambique District, Lourenço Marques.

QUISQUALIS INDICA, *Linn. Sp. Pl.* ed. ii. 556.

Sitatonga Hills, 2000 ft.; in fl. Nov.; n. 6501. A woody climber with handsome flowers.

Distrib. Widely distributed.

MYRTACEÆ.

EUGENIA CHIRINDENSIS, *E. G. Baker*, sp. nov.

Frutex vel arbuscula ramulis cortice cinereo tectis novellis in sicco ± applanatis glabris; foliis oppositis ovatis vel ovato-lanceolatis mediocriter petiolatis basi cuneatis ad apicem attenuatis apice ipso obtusis utrinque glabris superne nitidis costa subtus prominula nervis lateralibus utrinque 7–9 juxta marginem inter se conjunctis nervo intramarginali tenui, petiolo superne canaliculato; floribus parviusculis; pedicellis strictis fasciculatis quam alabastris 2–3-plo longioribus, prophyllis parvis calycis tubi $\frac{1}{3}$ partem attingentibus; calycis tubo turbinato glabro sepalis ovato-suborbicularibus margine ciliatis; petalis ovatis quam sepalis subduplo longioribus.

Hab. Chirinda Forest, 3700–4000 ft.; in fl. Dec., n. 128, in fl. Oct.; n. 443. Chipete Forest Patch, 3800 ft.; in fl. Oct.; n. 1343. A shrub or small tree. Flowers white, the discs becoming pink after the falling of the petals.

Folia 5·0–6·0 cm. longa, 2·0–3·0 cm. lata; petioli 5·0–7·0 mm. longi. Pedicelli 8·0–12·0 mm. longi. Calycis tubus 1·5 mm. longus. Sepala 1·5 mm. longa. Petala ±4 mm. longa.

Allied to *E. oligantha*, Baker.

EUGENIA ANGOLENSIS, *Engler in Notizbl. Bot. Gart. Berlin*, ii. (1899) 288.

Near Chirinda, 3800 ft.; in fl. Aug.; n. 242. A herb or shrublet about 2 ft. high, with black edible fruits. Flowers white.

Distrib. Angola.

E. CORDATA, *Laws. in Oliver, Fl. Trop. Afr.* ii. 438.

Syzygium cordifolium Klotzsch in Peters Mossamb. Bot. 63, t. 11.

Near Chirinda, 3800 ft.; in fl. Oct.; n. 25. A medium-sized tree with black edible fruit and dark rough bark. Chindao name, "Mukuti." Haroni River, 3500 ft.; in fl. Nov.; n. 1309. A small tree. Flowers white with pink calyx.

Distrib. Natal, Zululand, Angola, Lourenço Marques.

E. OWARIENSIS, *Beauv. Fl. Owar.* ii. 20, t. 70.

Chirinda, 3500 ft.; in fl. June; n. 23. Chimanimani Mts., 7000 ft.; in fl. Sept.; n. 642. Mt. Pene, 6500–7000 ft.; in fl. Sept.; n. 638. Sabi River, 1000 ft.; in fl. Nov.; n. 1311.

Forma LATIFOLIA, *Engler & Gilg.*

Near Chirinda, 3500 ft.: in fl. Oct.; n. 24. Chikore Hills, 3500 ft.; in fl. Nov.; n. 1304.

Distrib. (type) Widely distributed in Tropical Africa, but does not occur in Natal. (Forma *latifolia*) Lower Guinea, Mozambique District.

Mr. Swynnerton states that his n. 23 is a large and very handsome tree, height 80 ft., trunk diameter 3 ft., with tall straight trunk, smooth whitish bark, and a large crown of dense dark foliage.

MELASTOMACEÆ.

OSBECKIA SWYNNERTONII, *E. G. Baker*, sp. nov.

Suffrutex caule ramoso ramis junioribus pilis rufescentibus vel cinereis densiuscule tectis ad nodos incrassatis; foliis rigidiusculis oblongo-ovatis vel ovatis breviter petiolatis basi rotundatis vel cuneatis apice acutis utrinque pilis strigosis subdense obtectis conspicue 5-nerviis nervis marginalibus subtenuibus, petiolo pilis albidis vel rufescentibus tecto; floribus speciosis 5-meris in apice caulis ramorumque in cymas paucifloras confertas dispositis; receptaculo extus setis longiusculis et griseis dense vestito; calycis lobis cum appendicibus subulatis alternantibus lanceolatis tubo brevioribus; petalis (sec. cl. detectorem) purpureis late obovatis; staminibus 10 æqualibus vel subæqualibus connectivo antice bicalloso; stylo elongato; ovario apice setoso.

Hab. Chimanimani Mts. at 7000 ft.; n. 2085. In fl. Sept. 26th, 1906. Common amongst the crags. Rich purple flowers with bright yellow anthers.

Folia 3·0–5·0 cm. longa, 1·5–2·5 cm. lata. Petioli 4·0–6·0 mm. longi. Calycis

tubus ±10 mm. longus, laciniæ ±6 mm. longæ. Petala ±2·4 cm. longa, ±2·1 cm. lata. Antheræ ±8 mm. longæ. Stylus ±15 mm. longus.

This plant is evidently an ally of *Dissotis Melleri*, Hook. fil., from Mt. Chiradzura, but it has ten equal stamens, and the calyx-tube is much more densely clothed with longer bristles.

ANTHEROTOMA NAUDINI, *Hook. f. in Benth. & Hook. Gen.* i. 745.

Near Chirinda, 3800 ft.; in fr. July; n. 516.

Distrib. Abyssinia, Angola, Senegal, Nyasaland, Central African Lake Region. Also Madagascar.

DISSOTIS INCANA, *Triana in Trans. Linn. Soc.* xxviii. (1871) 58.

Near Chirinda, 3800 ft.; in fl. Dec.; n. 296.

Distrib. South Africa.

D. PRINCEPS, *Triana in Trans. Linn. Soc.* xxviii. (1871) 57.

Kloof near Chirinda, 3800 ft.; in fl. May; n. 526. A very tall branching herb common near water. Petals rich purple, bases of stamens pale yellow. Anthers deep purplish blue. Style crimson.

Distrib. Nyasaland, Mozambique, Natal.

TRISTEMMA INCOMPLETUM, *R. Br. in Tuckey, Congo, App.* 435.

Beira, open woods, 50 ft.; in fr. Dec.; n. 2086. A large herb with purple flowers.

Distrib. Upper and Lower Guinea, Lower Congo Region.

OLINIACEÆ.

OLINIA VANGUERIOIDES, *E. G. Baker*, sp. nov.

Arbor alta, ramulis novellis glabris cortice cinereo tectis; foliis oppositis lanceolatis vel oblongo-lanceolatis tenuiter coriaceis integris basi breviuscule petiolatis apice obtusis et sæpe mucronatis, costa superne impressa, nervis lateralibus tenuibus numerosis prope marginem conjunctis utrinque glabris; floribus ad apices ramulorum in cymas multifloras confertas dispositis; prophyllis foliis similibus nisi minoribus; receptaculo cylindraceo inferne paullo attenuato glabro, ostio circa perianthii insertionem extus obscure sinuato; sepalis sub anthesi erectiusculis oblongo-spathulatis concaviusculis apice ciliatis fauci receptaculi insertis; petalis cum sepalis alternantibus squamiformibus incurvis valvatis hirtis; antheris parvis connectivo ultra loculos producto; ovario infero imo receptaculo adnato; stylo erecto maxime compresso, ovario 5-loculari.

Hab. Umswirizwi head-waters, 3500 ft.; in fl. Dec.; n. 158. A large tree standing singly by banks of stream.

Arbor usque ad 15 m. attingens. Folia 8·0–10·0 cm. longa, 2·0–3·0 cm.

lata. Receptaculum 5·7 mm. longum. Sepala fere 2 mm. longa. Petala brevia.

Allied to *O. acuminata*, Klotzsch, but differing in the compressed style, &c. This plant has the aspect of *Vangueria lasiantha*, Sonder.

PASSIFLOREÆ.

TRYPHOSTEMMA SCHINZIANUM, *Harms in Engler & Prantl, Nat. Pflanzenfam.* iii. 6*a*. 72.

Kurumadzi, Jihu, 2000 ft.; in fl. Nov.; n. 2089. This agrees with the type in the Berlin Herbarium. A common fleshy climber with light greenish flowers.

Distrib. Mozambique.

TRYPHOSTEMMA (Eutryphostemma) PARVIFOLIUM, *E. G. Baker*, sp. nov.

Fruticulus. Rhizomate crasso; caulibus diffusis; foliis parviusculis brevissime petiolatis late ovatis vel suborbicularibus basi cordatis apice rotundatis apice ipso mucronatis glaucescentibus ad basin laminæ glandulis duabus plerumque instructis; stipulis minutis linearibus; pedunculis petiolos longe excedentibus sæpissime bifloris non in cirrhum conspicuum exeuntibus bracteis ad articulationem pedicelli sitis anguste linearibus; floribus (sec. cl. detectorum) pallide viridibus; sepalis 5 in sicco maculis purpureis notatis ellipticis vel late ovatis apice obtusis vel subacutis; corona extima cylindracea ore longe fimbriata, corona intima infundibuliformi hyalina; filamentis applanatis coronæ faciei interiore insertis; ovario ovoideo, stylis 3 filiformibus stigmata capitellata gerentibus staminibus subæquilongis, gynophoro brevi, fructu ignoto.

Hab. Hills between Lusitu and Melsetter, Rhodesia, 6000 ft.; n. 1415. In fl. Sept. 20th, 1906. A small plant. Flowers pale greenish.

Folia vix 1 cm. attingentia, 8–9 mm. lata. Sepala ±4 mm. longa. Corona exterior ±2 mm. alta. Filamenta fere 2 mm. longa. Ovarium ±1 mm. longum. Styli 1·5 mm. longi.

Allied to *T. Stuhlmanni*, Harms, but differing in the smaller leaves and the not cirrhose peduncle.

SCHLECHTERINA MITOSTEMMATOIDES, *Harms in Engler Jahrb.* xxxiii. (1902) 148.

Madanda Forest, at about 400 ft.; in fl. Dec.; n. 1233.

There is an interesting paper by Dr. Harms on the heterophyllism of this plant in the Bericht Deutsch. Bot. Ges. xxiv. 177, t. xii.

A climber woody and handsome, with greenish-white flowers. Anthers yellow.

Distrib. Lourenço Marques.

ADENIA (Blepharanthes) SENENSIS, *Engler, Jahrb.* xv. (1892) 573.

Jihu, Kurumadzi River, 2200 ft.; in fl. Jan.; n. 227. Lower Umswirizwi,

1000 ft.; in fr. Nov.; n. 2091 *a*. S. Umtali District, 2000–3000 ft.; in fl. Oct.; n. 6605. A climber common in the Jihu and found also in the neighbourhood of Chirinda.

Distrib. Mozambique District.

Ophiocaulon cissampeloides, *Masters in Oliver, Fl. Trop. Afr.* ii. 518.
Jihu, Kurumadzi River, 2000 ft.; in fl. Nov.; n. 2090. A climber.

Distrib. Upper and Lower Guinea.

CUCURBITACEÆ.

Peponia chirindensis, *E. G. Baker,* sp. nov.

Caulis scandens glaber vel subglaber, foliis membranaceis mediocriter petiolatis ambitu late cordato-suborbicularibus basi sinu lato apice subacuminato vix ad medium acute 3-lobatis lobis remotis divergentibus lobo medio majore margine undulatis remote et acute dentatis dentibus acutis utrinque præter nervos levibus vel sublevibus nervis palmatim dispositis subtus prominentibus cirrhis elongatis glabris inæqualiter bifidis; pedunculo communi masculo robusto 3–5-floro striato subglabro, pedicellis ad basin bracteatis, bracteis late ovatis apice rotundatis; calycis tubo subcylindrico extus subglabro intus pubescente dentibus angustis patulis quam tubo 3–4-plo brevioribus; petalis extus tomentosis (sec. cl. detectorem) citrinis; filamentis applanatis basi dilatatis quam antherarum capitulo brevioribus cum antheris in capitulum oblongum cohærentibus; fl. ♀ ignotis.

Hab. Chirinda outskirts, 3700–4000 ft.; n. 2102; in fl. Nov. 8th, 1906. A large fleshy climber with cucumber-like fruit and yellow flowers.

Folia ±6–10 cm. longa. Petioli 1·5–4·0 cm. longi. Calycis tubus ±2·0 cm. longus, dentes ±6 mm. longi. Petala ±3·5 cm. longa. Staminum filamenta ±6 mm. longa, capitulum antherarum ±13 mm. longum.

Allied to *P. Boivini*, Cogn., but differing in the larger flowers, the always bifid cirrhi, and the broader bracts.

Momordica fœtida, *Schum. & Thonn. Pl. Guin.* 426.
Chirinda Forest, 3700–4000 ft.; in fl. Dec.; n. 94. Kurumadzi R., Jihu, 2000 ft.; in fl. Nov.; n. 2087.

Distrib. Widely distributed in Tropical Africa.

Cucumis Zeyheri, *Sond. in Harv. & Sond. Fl. Cap.* ii. 496.
Chirinda outskirts, 3800 ft.; in fl. May; n. 456.

Distrib. South Africa, Natal.

Melothria longepedunculata, *Cogn. Mon.* 613 (forma).
Chirinda Forest, 3700–4000 ft.; in fl. Jan.; n. 232. A climber with small white flowers.

Distrib. Abyssinia, German East Africa, Arabia.

CACTACEÆ.

Rhipsalis Cassytha, *Gaertn. Fruct.* i. 137, tab. 28.

Mt. Maruma, 3500 ft.; n. 1085; Chirinda Forest, 3700–4000 ft.; in fl. Nov.; n. 1086.

Distrib. Widely distributed in Tropical Africa. Also in Ceylon, Mauritius, and Tropical America.

FICOIDEÆ.

Orygia decumbens, *Forsk. Fl. Æg.-Arab.* 103.

Chibabava, Lower Buzi, 400 ft.; in fr. Nov.; n. 2095. Umtefu River, Lower Buzi, 500 ft.; in fr. Dec.; n. 2096. A common weed in cultivated ground. Flowers purple.

Distrib. Widely distributed in Africa, also eastward to India.

Gisekia pharnaceoides, *Linn.*, var. pedunculata, *Oliver in Fl. Trop. Afr.* ii. 594.

Madanda Forest at about 400 ft.; in fl. Dec.; n. 2097. Chibabava, Lower Buzi, 400 ft.; in fl. Dec.; n. 2158. A herb with whitish flowers.

Distrib. The species is widely distributed in Africa and also occurs in India.

UMBELLIFERÆ.

Hydrocotyle moschata, *Forst. f. Prod.* 22.

Chirinda Forest, 3800 ft.; in fr. April; n. 347.

Distrib. Upper Guinea, Mozambique District. Also Bourbon, New Zealand, &c.

Alepidea amatymbica, *Ecklon & Zeyher, Enum.* 339.

Near Chirinda, 3500 ft.; n. 233.

Distrib. S. Africa.

Sanicula europæa, *Linn. Sp. Pl.* 235.

Chirinda Forest, 3700–4000 ft.; in fl. April; n. 346. A herb with whitish flowers.

Distrib. Mt. Kilimanjaro, Ruwenzori, Cameroons. Also Europe and Temp. Asia.

Heteromorpha arborescens, *Cham. & Schlecht. in Linnæa*, i. (1826) 385.

Near Chirinda, 400 ft.; in fl. & fr. April; no. 182. Lusitu River, 4000 ft.; in fr.; n. 2091.

Distrib. South Africa.

Lefeburia benguellensis, *Welw. ex Engler, Hochgebirgsfl.* 322.

Near Chirinda, 3800 ft.; in fr. May; n. 395.

Distrib. Benguella.

Physotrichia Swynnertonii, *E. G. Baker*, sp. nov.

Herba elata caule tereti glabro erecto striatulo glaucescente; foliorum petiolo brevi vaginato; foliis caulescentibus bipinnatis pennis 2–3-jugis, foliolis lateralibus oblongis vel anguste ovato-oblongis apice acutis quam iis *P. Buchanani*, Benth. multoties angustioribus viridibus sessilibus; umbellis pluriradiatis longe pedunculatis, involucri bracteis demum reflexis lanceolatis margine submembranaceis quam pedunculis brevioribus, involucellorum bracteis subsimilibus sed minoribus; petalis ovatis apicem versus angustatis inflexis (sec. cl. detectorem) albis dorso puberulis; disco crasso; stylis tenuibus erectis; fructibus hirtellis oblongis subteretibus jugis primariis prominulis.

Hab. Melsetter, alt. 6000 ft.; in fl. & young fr. Sept.; n. 649. A tall slender herb with white flowers.

Planta ex schedis cl. detectoris "8–9 ped." alta. Folia radicalia non vidi, caulescentia 9·0–11·0 cm. longa. Foliola 3·0–4·0 cm., longa, 8·0–12·0 mm. lata. Involucri bracteæ 10–18 mm. longæ, involucellorum bracteæ 4–6 mm. longæ. Pedunculi fructiferi 2·0–4·5 cm. longi. Pedicelli 4·0–10·0 mm. longi.

Differs from *P. Buchanani*, Benth., in the narrower leaflets.

Peucedanum fraxinifolium, *Hiern ex Oliver, in Trans. Linn. Soc.* xxix. (1873) 79, t. 42.

Lower Umswirizwi, 1000 ft.; in fr. Nov.; n. 176.

Distrib. Widely distributed in Tropical Africa.

ARALIACEÆ.

Cussonia umbellifera, *Sond. in Linnæa*, xxiii. (1850) 49.

Common tree of Chimanimani Forest; in fr. Sept.; n. 653 *a*.

Distrib. South Africa.

C. spicata, *Thunb. Nov. Act. Upsal.* iii. (1780) 212, t. 13.

Near Chirinda, 3800 ft.; n. 159. A small tree. Chimanimani Mts., 7000 ft.; n. 2092.

Distrib. South Africa, Mozambique District.

CORNACEÆ.

Curtisia faginea, *Aiton, Hort. Kew.* i. 162.

Chimanimani Mts., 7000 ft.; in fl. & fr. Sept.; n. 637. The commonest tree of the Chimanimani Forest and glens, with handsome glossy foliage.

Distrib. South Africa.

W. Wangerin, in his recent Monograph of Cornaceæ (Pflanzenreich, iv. 29. 30), does not record this tree as occurring in Tropical Africa.

GAMOPETALÆ.

By SPENCER MOORE, B.Sc., F.L.S.

RUBIACEÆ.

CEPHALANTHUS NATALENSIS, *Oliver in Hook. Ic. Pl.* t. 1331.

Heights overlooking Lusitu River, 4000 ft.; in fl. Sept.; n. 645.

Distrib. Natal and Transvaal.

The fruits are edible and make an excellent jam, the flavour being between that of raspberry and gooseberry.

ADINA MICROCEPHALA, *Hiern in Oliver, Fl. Trop. Afr.* iii. 40.

Upper Inyamadzi near Chirinda, 3300 ft.; in fl. Dec.; n. 26.

Distrib. Nubia to Nyassaland and Angola, Swaziland, Madagascar.

Chindao name, "Mowana." A handsome, tall evergreen tree with wide and straight shaft, growing exclusively along the banks of streams and rivers. Roots bitter, commonly chewed by the natives as a remedy for colic, or drunk in the form of an infusion with water.

CROSSOPTERYX KOTSCHYANA, *Fenzl in Nov. Stirp. Dec.* 45.

Madanda forests at about 400 ft.; in fl. Dec.; n. 1399.

Distrib. Tropical Africa.

PENTAS PURPUREA, *Oliver in Trans. Linn. Soc.* xxix. (1873) 83.

Kurumadzi River, Jihu, 2000 ft.; near Chirinda, 3800 ft.; in fl. Feb., April, June; nos. 274, 1152, 2143.

Distrib. Tropical East Africa.

Chindao name, "Munyamshawa." The roots are said to be crushed into a gruel for pains in the stomach.

OTOMERIA DILATATA, *Hiern in Oliver, Fl. Trop. Afr.* iii. 50.

Kurumadzi River, Jihu, 2000 ft.; Upper Buzi, 3000 ft.; fl. & fr. Nov., Dec.; nn. 355, 2144.

Distrib. S.E. tropical Africa.

A fairly tall herb with red flowers, found in swamps and on the banks of streams.

PENTODON DECUMBENS, *Hochst. in Flora,* xxvii. (1844) 552.

Open woods at Beira and Boka-Inyamita, Lower Buzi; in fl. & fr. Dec.; nn. 758, 1893.

Distrib. Eastern tropical Africa.

OLDENLANDIA CYNANCHICA, *K. Schum. in Kuntze Rev. Gen. Plant.* iii. 121.

Melsetter at 6000 ft.; fl. Oct.; n. 6107.

Distrib. South Africa.

A herb common on mountain north of Melsetter.

O. CAFFRA, *Eckl. & Zeyh. Enum.* 360.

Muchukwana, Lower Buzi, 400 ft.; in fl. & fr. Dec.; n. 2139.

Distrib. Tropical and South Africa.

O. BOJERI, *Hiern in Oliver, Fl. Trop. Afr.* iii. 53.

In short grass near Chirinda; Madanda forests at about 400 ft.; open woods, Beira; fl. & fr. May; nn. 500, 2153, 2153 *a*.

Distrib. East tropical Africa and Mascarene Islands.

O. NATALENSIS, *O. Kuntze, Rev. Gen. Plant.* i. 292.

Near Chirinda, 3800 ft.; fl. & fr. July; n. 303.

Distrib. Natal and Zululand.

O. WELWITSCHII, *Hiern in Cat. Welw. Afr. Pl.* i. 442.

Madanda forests at about 400 ft.; in. fl. & fr. Dec.; n. 2140.

Distrib. Angola.

Different from typical *O. Welwitschii* in the taller habit, the scattered (not rosulate) leaves, the smaller, more globular ovaries and fruits, and shorter calyx-lobes. The specimens agree fairly well in these points with Baum 599, which is referred to *O. Welwitschii* (Kunene-Sambesi Exped. p. 382). With a larger range of material to judge from this may prove a distinct species.

O. TRINERVIA, *Retz. Obs.* iv. 23.

Inyamadzi Valley, 2500 ft.; Chimanimani Mts. at 7000 ft.; in fl. Sept.; nn. 1527, 1534.

Distrib. Tropical Africa, Mascarene Islands, East Indies.

O. HIRTULA, *O. Kuntze, Rev. Gen. Plant.* ii. 292.

Chimanimani Mts. at 7000 ft.; in fl. Sept.; n. 2152.

Distrib. Rhodesia (*Eyles* 346 in herb. Mus. Brit.) and South Africa.

The tropical specimens are nearly glabrous, otherwise they resemble the South African.

MUSSÆNDA ARCUATA, *Poir. in Lam. Encycl.* iv. 392.

Spungabera forest patch, 3700 ft., and Chirinda Forest at 3800 ft.; fl. Dec. and March; young fr. March; nn. 119, 6636.

Distrib. African tropics and Mascarene Islands.

UROPHYLLUM SYMPLOCOIDES, *S. Moore*, sp. nov.

Frutex ramulis attenuatis pendulis crebre foliosis novellis summum puberulis, foliis brevipetiolatis lineari-lanceolatis acuminatis basi acutis papyraceis utrobique, costarum axillis faciei inferioris pubescentibus exemptis, glabris in sicco læte viridibus vel viridi-olivaceis nitidis subtus pallidioribus, costis secundariis utrinque 8–9 aperte arcuatis in pagina inferiore magis prominulis, stipulis parvulis e basi lata gradatim attenuatis superne subulato-acuminatis inter se liberis, floribus mediocribus solitatim (rarius 2–3) ex axillis ortis, pedicellis quam folia multo brevioribus juxta medium bibracteatis puberulis, calycis microscopice puberuli limbo quam ovarium hemisphæricum paullo longiore in lobos 5 inferne triangulares superne subulatos alte diviso, corollæ vix usque ad medium lobatæ tubo calycem breviter excedente sursum levissime ampliato intus villosulo lobis 5 lanceolato-oblongis obtusis, staminibus breviter exsertis, ovario 4-loculari, stylo incluso glabro quam stigma biramosum paullo longiore, bacca globosa calyce accrescente onusta puberula.

Hab. Mt. Pene Forest at 6500 ft.; in fl. Sept.; n. 1278. Also Nyasaland, Mt. Milanji at 6000 ft.; *A. Whyte* (in fruit).

Ramuli subteretes, ægre 1 mm. diam. Folia 5–10 cm. long., juxta medium 8–15 mm. lat.; petioli puberuli, 3–5 mm. long. Stipulæ solemniter 4 mm. long Inflorescentiæ (flore incluso) summum 1 cm. long. Bracteæ lanceolatæ ± 1·5 mm. long. Flores lutescenti-albidi. Ovarium 1·2 mm. long., calycis limbus 2 mm. long. Corolla tota 6·5 mm long.; tubus 3·5 mm. long., basi 2·5 mm., ore 3 mm. lat. Filamenta 1 mm. long., antheræ totidem. Stylus 1·5 mm., stigmatis rami 0·8 mm. long. Bacca viridis, in sicco 1 cm. diam., calyx coronans 4 mm. long., 4·5 mm. lat.

Known among other features by the narrow leaves, the very short inflorescences even when the flowers are not solitary, and the subulate lobes of the calyx.

HEINSIA JASMINIFLORA, *DC. Prodr.* iv. 390.

Open woods at Beira; Madanda forests at about 400 ft.; Jihu, Mt. Singuno at 1500 ft.; Chirinda Forest, 3700 ft.; in fl. Nov., Dec.; nn. 134, 1139, 1257, 1258.

Distrib. Tropical Africa generally.

LEPTACTINIA HEINSIOIDES, *Hiern in Oliver, Fl. Trop. Afr.* iii. 88.

Open woods at Beira and Madanda forests at about 4000 ft.; fl. & fr. Dec.; nos. 1266, 1267.

Distrib. S.E. tropical Africa.

ENTEROSPERMUM LITTORALE, *Hiern in Oliver, Fl. Trop. Afr.* iii. 93.

Beira beach; in fl. Dec.; n. 1265.

Distrib. Shore of East tropical Africa.

RANDIA SWYNNERTONII, *S. Moore*, sp. nov.

Frutex ramosus, spinosus, ramis sat tenuibus teretibus cito glabris ultimis solummodo foliosis perbrevibus sub spinis ortis squamulis arcte obductis, foliis pro rata parvis brevipetiolatis oblanceolatis vel oblongo-obovatis obtusissimis basi attenuatis firme membranaceis glabris vel minute pubescentibus, stipulis parvulis e basi lata subulato-setaceis puberulis, floribus ex axillis ramulorum juvenilium solitatim ortis raro binis brevipedunculatis, pedunculis tomentellis, ovario subhemisphærico tomentello quam calyx breviore, calycis campanulati tomentelli ultra medium divisi lobis rotundato-obovatis obtusissimis basi contractis, corollæ extus pubescentis tubo quam calyx breviore intus juxta medium annulatim barbato lobis tubo æquilongis late obovatis obtusissimis margine leviter undulatis, staminibus paullo infra os insertis, stylo incrassato sursum contracto quam stigma ovideo-oblongum longitrorsum sulcatum paullulum longiore.

Hab. Lower Umswirizwi River, 1000 ft.; in fl. Nov.; n. 1910.

Rami ascendentes rarius subpatuli. Spinæ quam eæ *R. niloticæ*, Stapf, debiliores, patentes, ± 1 cm. long. Folia 1·5–4 cm. long., 6–20 mm. lat., in sicco aliquanto castanea; costæ secundariæ utrinque 3–4, tenerrimæ; petioli 3–7 mm. long. Stipulæ circa 2 mm. long. Pedunculi ± 5 mm. long. Flores albi. Ovarium ægre 3 mm. long. et lat. Calycis limbus 3 mm. long., dentibus interpositis minimis nonnunquam obsoletis; lobi 5 mm. long., 3·5 mm. lat. Corollæ tubus 5 mm. long., 3 mm. lat.; lobi 5 mm. long. Antheræ subsessiles, oblongæ, obtusæ, 3·5–4 mm. long. Stylus 4·5 mm. long., inferne 1 mm. sub stigmate 0·5 mm. lat.; stigma 3 × 2 mm.

Near *R. nilotica*, Stapf, and *R. Lachnosiphonium*, Hochst., and more like the latter in habit, but the branches are always spinous. From both it is distinguished by the shortly peduncled flowers, the tomentose calyces, and small corollas.

GARDENIA NEUBERIA, *Eckl. & Zeyh. Enum.* 360.

Umvumvumvu River, 4000 ft.; Madanda forests, 400 ft.; in fl. April, Dec.; nos. 1401, 2149.

Distrib. South Africa.

GARDENIA NORÆ, *Swynnerton*, sp. nov.

Fruticosa, elata, deinde valide spinosa, ramis cortice griseo-albido obductis, ramulis juvenilibus cinereis glabris ad nodos tumidis, foliis brevipetiolatis lanceolatis vel oblongo-lanceolatis acutis interdum aliquanto acuminatis costis lateralibus utrinque 4–6 arcuatim ascendentibus papyraceis glabris pallide nitidis, stipulis e basi lata abbreviatis subulatis, floribus in axillis superioribus solitariis oppositis pendentibus pro rata majusculis, pedunculis glabris calyce 2–3-plo longioribus, calyce parvo campanulato glabro tubo (ovario) quam limbus in lobos 5 triangulari-subulatos alte divisus longiore, corolla cam-

panulata (inferne anguste cylindrico-infundibuliformi) albo-virescente lobis 5 quam tubus multo brevioribus oblongo-ovatis acutiusculis patentibus, antheris sessilibus infra fauces æquialte insertis, stylo incluso, stigmate fusiformi apice bilobo lobis subrotundatis obtusissimis, bacca coriacea globosa prominenter costata dilute viridi, seminibus pluribus complanatis vel rotundis.

Hab. Chirinda Forest, 3700–4000 ft.; in fl. Jan.; n. 11.

Frutex 6–8 m. altus. Spinæ (monente cl. detectore) arrectæ, 10–30 mm. long. Folia 6·5–10 cm. × 2–3·5 cm., viva saturate viridia, sicca olivacea; pagina inferiore paullo pallidiora; petioli crassiusculi, 3–10 mm. long. Stipularum 14 mm. long. pars dilatata 2 mm. long. Pedunculi 10–14 mm. long., sub fructu incrassati et 22 mm. attingentes. Ovarium circa 4 mm. long. Calycis limbus totus 5 mm. long., ejus lobi 3·5 mm. Corollæ tubus 6·4 cm. long., ima basi 5 mm., juxta medium 2 cm., faucibus 3·3 cm. diam. Antheræ 15 mm. long. Stylus circa 4·8 cm. long.; stigma 16 × 6 mm., lobi 2·5 mm. long. Bacca 2·5 × 2·5 cm. Semina circa 11 × 11 mm., sordide alba.

Outwardly very like *G. konguensis*, Hiern, but the leaves are smaller and relatively broader, and the corolla is narrowed from near the middle to the base instead of narrowing suddenly. The insertion of the stamens is also different in the two cases.

A large, handsome shrub with glossy evergreen foliage and drooping branches. The bark is smooth and grey, and studded with blunt thorns.

GARDENIA POSOQUERIOIDES, *S. Moore*, sp. nov.

Frutex elatus, glaber, ramulis juvenilibus subtetragonis mox cortice sordido longitrorsum rimoso circumdatis, foliis oppositis ternisve oblongis vel ovato-oblongis vel anguste oblongo-obovatis apice cuspidato-acuminatis basi in petiolum brevem attenuatis tenuiter coriaceis nitidis facie inferiore aliquanto pallidis costis secundariis utrinque 8–10 ascendenti-patulis marginem versus arcuato-undulatis, stipulis ovatis vel ovato-triangularibus obtusis obtusissimisve unilateraliter connatis membranaceis, floribus magnis hexameris terminalibus solitariis breviter pedunculatis, calycis tubo (ovario) cylindrico-fusiformi in longitudinem sulcato limbo usque ad $\frac{2}{3}$ in lobos lineares obtuse acutos diviso, corollæ hypocrateriformis tubo calycem multo excedente sursum leviter amplificato lobis late oblongis obtusissimis tubum vix semiæquantibus, staminibus faucibus insertis, filamentis brevibus antheris elongatis linearibus, ovario 1-loculari placentis 3 induto, stigmate brevissime exserto.

Hab. Chirinda Forest, 3700–4000 ft.; in fl. Nov., Jan.; nos. 71, 6504.

Folia sæpe 10–14 cm. long., 4·5–6 cm. lat.; accedunt interdum alia ex eodem nodo orta circa 7 × 3 cm. vel etiam minora; petioli 0·5–1 cm. long. Stipulæ 1–1·5 cm. long. Pedunculus incrassatus, summum 8 mm. long. Ovarium 1·5 cm. long., basi 4 mm., sursum 5 mm. lat. Calycis limbus 1·5 cm. long.; lobi 3–3·5 cm. long., humectati adusque 2 mm. lat. Corollæ albæ tubus 11 cm. long., inferne 0·5 cm., juxta fauces piloso-villosulas 1 cm.

diam.; lobi basi appresse piloso-pubescentes, 5 × 2 cm. Filamenta gracilia, 2·2 mm. long.; antheræ maxima pro parte inclusæ, circa 2 cm. long. Stylus piloso-puberulus, 10 cm. long. Stigma late clavatum, sulcatum, apice breviter lobatum, 1·3 cm. long. Fructus fusiformis, calyce persistente coronatus, coriaceus, viridis, costis 6 maxime eminentibus spongiosis indutus, 6 × 2 cm. Semina numerosa, 8 × 4·5 mm.

A plant in the style of *G. assimilis*, Afz., but different in many respects.

GARDENIA TIGRINA, *Welw. ex Hiern, Cat. Welw. Pl.* i. 462.

Chirinda Forest, 3700–4000 ft.; Mt. Maruma Forest, 3500 ft.; in fl. Oct., fr. Feb.; n. 10.

Distrib. Angola.

Chindao name, "Mutambawebungu." One of the commonest trees in Chirinda, reaching 80 ft. in height. The large, glossy, fusiform green fruits are great favourites with the forest monkeys (*Cercopithecus albigularis*).

G. ASPERULA, *Stapf & Hutch. in Journ. Linn. Soc.* xxxviii. (1909) 423.

Melsetter, 3500 ft.; Chikore Hills, 3500 ft.; in fl. Oct., Nov.; nos. 56, 56 *a*.

Distrib. Zambesia and Nyasaland.

Singuni name, "Isivalesang weni" (kraal-door). Used by the natives for its thorns and toughness to close kraal-gates against lions.

G. SPATULIFOLIA, *Stapf & Hutch. in Journ. Linn. Soc.* xxxviii. (1909) 424.

Sabi River at about 1000 ft.; in fl. Nov.; n. 715.

Distrib. Angola to Rhodesia.

OXYANTHUS MONTEIROÆ, *N. E. Br. in Kew Bull.* 1892, 125.

O. Schlechteri, K. Schum.

Madanda forests at about 400 ft.; fl. & fr. Dec.; n. 579.

Distrib. Portuguese East Africa.

A large shrub with white flowers.

O. GERRARDI, *Sond. in Harv. Fl. Cap.* iii. 31.

Chirinda Forest, 3700–4000 ft.; fl. & fr. Jan., Feb.; n. 116.

Distrib. Mozambique and Natal.

The specimens bear ripe fruits and also flowers in an early stage. The flowers not being matured some doubt must rest upon this identification.

OXYANTHUS SWYNNERTONII, *S. Moore*, sp. nov.

Fruticosus, ramis complanatis deinde subteretibus glabris, foliis ellipticis vel elliptico-oblongis sursum cuspidato-acuminatis apice obtusiusculis basi obtusis petiolis brevibus canaliculatis insidentibus tenuiter coriaceis supra

glabris subtus scabridis costis secundariis utrinque circa 8 ascendenti-patulis marginem versus aperte arcuatis, stipulis lanceolato-linearibus longe acuminatis, floribus majusculis brevipedicellatis in corymbos breves axillares bracteatos paucifloros digestis, bracteis parvulis cymbiformibus a latere visis subulatis acuminatis margine ciliolatis, ovario quam calyx breviore anguste ovoideo-oblongo longitrorsum costato 2-loculari, calycis limbo late cylindrico lobis lineari-lanceolatis acuminatis æquilongo, corollæ tubo lobos suos magnopere superante extus glabro intus inferne piloso-pubescente lobis oblongis obtusis basin versus leviter angustatis, antheris sessilibus linearibus apice apiculatis basi sagittulatis, stigmate exserto fusiformi bifido, bacca anguste ellipsoidea basi apiceque obtusa.

Hab. Chirinda Forest, 3700–4000 ft., and Boka, Lower Buzi River; fl. Oct.–Dec., fr. Dec.; nos. 76, 135, 580, 6637.

Folia 10–12 cm. long., 3·5–4·7 cm. lat., supra nitidula subtus pallida, in sicco griseo- vel brunneo-viridia; petioli circa 5 mm. long. Stipulæ sæpissime 1·5–2·5 cm. long. Racemi floribus exemptis ± 1 cm. long. Bracteæ 6–8 mm. long. Pedicelli ± 4 mm. long. Flores albi. Ovarium 4 mm., calycis limbus 4 mm., ejus lobi 3–4 mm. long. Corollæ tubus 8–9 cm. long., humectatus 2·5 mm. lat.; lobi 2–2·5 cm. long. Antheræ 4·5 mm. long. Stylus 11 cm. long.; stigma 6·5 mm. long., summum vix 1 mm. lat. Bacca 4–4·5 × 1·5–2 cm., in sicco longitrorsum striata. Semina fusca, 4 × 3 mm.

Near *O. speciosus*, DC., but different in bracts, flowers, and fruit. The fruits emit a strong and unpleasant musky smell.

Var. BREVIFLORUS, *S. Moore*, var. nov. Corollæ solummodo 5·5 cm. longa; ceteroquin ut typus.

Hab. Chirinda Forest; in fl. Nov.; n. 76 *a*.

TRICALYSIA MYRTIFOLIA, *S. Moore*, sp. nov.

Frutex elatus, diffusus, ramulis subteretibus nudis cortice cinereo circumdatis ultimis attenuatis foliosis minute pubescentibus, foliis anguste oblongo-oblanceolatis obtusis vel obtusissimis in petiolum perbrevem gradatim angustatis tenuiter coriaceis supra glabris subtus præsertim in costa centrali valde eminente obscure puberulis costis secundariis utrinque 6–8 haud perspicuis, stipulis parvulis lineari-lanceolatis acuminatis extus puberulis, cymis sessilibus plurifloris, calyculo simplici ore dentato ut calycis limbus dentatus cinereo-sericeo, calycis tubo (ovario) turbinato glabro quam limbus breviore, corollæ tubo calycem breviter excedente extus glabro lobis 6 oblongis obtusis limbo æquilongis extus sericeis intus apicem versus puberulis ceterum glabris, staminibus 6 filamentis brevibus antheris oblongis obtusis, stylo piloso-puberulo ramis incrassatis, ovulis quove in loculo 2 collateralibus.

Hab. Mt. Maruma, 3500 ft.; Upper Inyamadzi Valley, 3000 ft.; hills overlooking Upper Buzi River at 3500 ft.; in fl. April, Sept., Oct.; nos. 684, 1133, 1283.

Folia solemniter 4–5 cm. long., 1·5–2 cm. lat., in sicco læte viridia, costulæ reticulatæ parum vero aspectabiles; petioli ad summum 2 mm. long. Stipulæ 3 mm long. Cymæ corollis exemptis 5 × 8 mm. Calyculus 2·5 mm. long. Flores dilute virescentes. Ovarium 1 mm. long., calycis limbus 2 mm. Corollæ tubus ut lobi 3·5 mm. long., ille 1·5 mm. diam. faucibus pilosis, hi cito reflexi. Filamenta 1·5 mm., antheræ 3·25 mm. long. Stylus 3 mm. long., ejus rami 3 mm.

The affinity is with *T. pallens*, Hiern, which has larger elliptical leaves, truncate stipules, a pubescent calyculus and calyx, &c.

TRICALYSIA LIGUSTRINA, *S. Moore*, sp. nov.

Frutex ultrametralis, ramulis ascedentibus gracilibus subteretibus sparsim foliosis puberulis cito glabris, foliis parvis lanceolatis sæpius equidem lineari-lanceolatis acutis basi obtusis tenuiter coriaceis supra et subtus glabris costis secundariis utrinque 4–6 facile aspectabilibus etsi tenuibus, stipulis inferne latis subito in aristam rigidam fuscam iis fere æquilongam exeuntibus extus puberulis, cymis abbreviatis paucifloris nonnunquam ad florem unicum redactis, calyculo simplici (inflorescentiarum uniflorarum duplici) quam calycis limbus breviore ore truncato, ovario turbinato glabro calycis limbo breviore, calycis limbo dentato ut calyculus appresse sericeo-pubescente, corollæ tubo calycem longe excedente extus puberulo lobis anguste oblongo-obovatis obtusis marginibus revolutis extus pubescentibus intus glabris, staminibus 6 filamentis abbreviatis antheris oblongis obtusis, stylo breviter exserto glabro quam rami sui crassiusculi longiore, ovulis quove in loculo 2 collateralibus.

Hab. On schistose hills near the Upper Buzi at 3000 ft.; in fl. Sept., Oct.; nos. 685, 1284.

Foliorum limbus 4–5 cm. long., 1–1·5 cm. (raro 2 cm.) lat., in sicco brunneo-viridis; costulæ ægre aspectabiles; petioli lati, canaliculati, puberuli, 2 mm. long. Stipulæ 2·5–3·5 mm. long. Cymæ corollis exemptis 4 mm. long. Calyculus 1·2 mm. long. Flores albi. Ovarium 1 mm. long. Calycis limbus tandem irregulariter ruptus, 2 mm. long. Corollæ tubus sursum leviter gradatim ampliatus, 6·5–7·5 mm. long., inferne 0·6 mm superne 1·2 mm. lat.; lobi 4 mm. long. Filamenta 1 mm., antheræ 4 mm. long. Stylus 6·5 mm., rami 2·5 mm. long.

Nearest *T. crassifolia*, Benth. & Hook. fil., but distinguished from it *inter alia* by the leaves and the corollas with long tube and lobes markedly shorter than the tube.

N. 1287 from Madanda forests on ant-heaps may belong here, but the specimens are without flowers.

TRICALYSIA PACHYSTIGMA, *K. Schum. in Engl. Jahrb.* xxxiii. (1903) 347.

Chimanimani crags, 6500 ft.; Mt. Pene, 6500–7000 ft.; in fl. Sept., Oct.; nos. 641, 1134 & 6068.

Distrib. Nyasaland, Rhodesia.

HEINSENIA SYLVESTRIS, *S. Moore*, sp. nov. (Pl. **4.**)

Arbuscula ramulis sat gracilibus cito glabris et cortice sordido longitrorsum rimoso præditis, foliis brevipetiolatis lanceolato-obovatis apice obtusis interdum cuspidatis vel caudato-acuminatis basin versus cuneatim coartatis supra glabris subtus secus nervos appresse puberulis, stipulis abbreviatis e basi lata triangulari-subulatis caducis, floribus pedicellatis in paniculas breves pauci-floras copiose bracteatas pubescentes ramulis valde redactis terminalibus suffultas dispositis, bracteis parvulis ovatis breviter acuminatis appresse pubescentibus, calycis appresse puberuli tubo (ovario) late turbinato quam limbus fere adusque medium lobatus breviore lobis e basi lata subulatis inter se sæpe inæqualibus, corollæ campanulatæ puberulæ tubo sursum dilatato calycem 5-plo excedente lobis obovatis obtusissimis tubo brevioribus, antheris elongatis linearibus subinclusis, styli ramis lineari-oblongis obtusis.

Hab. Chirinda Forest, 3700–4000 ft.; in fl. Oct.; nos. 576 & 689.

Folia 7–10 cm. long., juxta medium 4–5 cm. lat., firme membranacea, in sicco brunnescentia, subtus paullo pallidiora; costæ secundariæ utrinque 4, arcuatim ascendentes, facie superiore impressa inferiore eminentes; petioli circa 1 cm. long., supra canaliculati, dorso puberuli. Stipulæ summum 5 mm. long. Panicula (floribus haud exemptis) 1·5–3 cm. long. Pedunculus i. e. ramus suffulciens adusque 3·5 mm. long., glaber. Bracteæ 1·5–2 mm. long., persistentes. Pedicelli graciles, appresse puberuli, 2–6 mm. long. Flores albi intus purpureo-maculati. Ovarium 2 mm., calycis limbus totus 4 mm. long., hujus lobi 1·4 mm. longi vel breviores. Corollæ tubus fere 1 cm. long., basi 2 mm. diam. subito ad 3 mm. dilatatus, inde usque ad fauces 9 mm. diam. gradatim ampliatus; lobi 6×5 mm., conspicue nervosi. Filamenta juxta medium tubum inserta; antheræ 6 mm. long. Stylus glaber, 5·5 mm. long.; rami crassiusculi, 5 mm. long. Bacca subglobosa, $5 \times 4{\cdot}5$ mm., puberula.

From *H. diervilloides*, K. Schum., the present plant differs in shape of leaf, in the much larger calyx with lobes often unequal, the corolla-tube broader at base and suddenly, not gradually, expanded, &c. The flowers are white with crimson specks, and look like those of *Gardenia tigrina* in miniature.

Schumann described the style of *H. diervilloides* as undivided and pluricostate, and this appears to be the case with *H. sylvestris* on superficial examination. I find, however, the swollen upper part of the style, after a couple of days in water, to divide easily into two stigmatic arms as described, a division which can be brought about even by gently rolling the style between thumb and forefinger.

An oversight of greater importance relates to the ovules of this genus

Both Schumann (Engl. Bot. Jahrb. xxiii. 453) and De Wildeman describe and the latter (Pl. Nov. Hort. Then. i. t. 3) figures the ovule as solitary. On opening a cell of the ovary is seen a biscuit-shaped body—apparently a single ovule—hanging from the top of the cell. The width of this body in relation to its length, however, made me suspect its homogeneity; accordingly it was examined under a low power of the compound microscope, when, as shown in Pl. **4**. fig. 5, a couple of sharp points were seen projecting from either angle at the upper end. Sectioning showed each of these points to be the free portion of an ovule, the rest lying buried in the placentary tissue just as, for instance, is the case with the ovule of Myrsineæ. Fig. 6 represents semidiagrammatically the placenta with its two ovules; in this the integument and the pyriform nucellus are well shown. There being only dried material to hand, no further details concerning these ovules are discoverable. One would much like to know how this singular body behaves in maturation; possibly the second ovule at length aborts, and the food-stuff accumulated in its tissues and in that of the placenta serves to nourish the survivor.

The result of this discovery is that *Heinsenia* must be removed from the Alberteæ, where Schumann placed it, to the Gardenieæ, next to *Empogona*.

[The genus is also represented in Uganda, whence Mr. E. Brown has recently sent specimens to the British Museum of the following:—

Heinsenia Brownii, *S. Moore*, sp. nov.

Fruticosa, ramulis distanter foliosis cito glabris novellis pubescentibus, foliis brevipetiolatis oblongo-ellipticis obtusis basi acutis membranaceis utrobique nervis paginæ inferioris appresse puberulis exemptis glabris, cymis axillaribus subsessilibus plurifloris, bracteis parvulis ovatis dense sericeis, floribus subsessilibus, calycis campanulati sericei limbo quam ovarium plane longiore tandem fisso lobis acuminatis, corolla campanulata extus sericea triente superiore divisa lobis late ovatis obtusis, antheris linearibus inclusis apice acutis, styli ramis complanatis clavellatis.

Hab. Mabira Forest; *E. Brown*, 429.

Folia 8–10 × 3–4·5 cm., in sicco griseo-viridia; costæ ordinis secundi utrinque 6, ascendentes, interdum levissime arcuati; petioli 5–10 mm. long. Cymæ (corollis inclusis) circa 1·5 × 2 cm. Pedunculus summum 3 mm. long., sæpius 1–2 mm. Bracteæ circa 2 mm. long. Flores albi. Ovarium turbinatum, sericeum, 1·25 mm. long. Calycis limbus 3·5 mm. long.; hujus lobi 1 mm. long. Corolla 1 cm. long.; tubus cylindricus, inferne 2 mm. lat., inde dilatatus, ore 8 mm. lat.; lobi 4 × 3–3·5 mm. Antheræ 5 mm. long. Stylus 5 mm. long., hujus rami ægre totidem.

Differs from *H. Lujæ*, De Wild., known to me only by figure and description, in the sessile or almost sessile cymes, the acuminate lobes of the calyx, of which the tube is ultimately split down one or both sides, as occurs with

Tricalysia, and the markedly shorter and broader corolla with shorter and broader lobes.]

The species may thus be distinguished :—

Corolla at most puberulous outside.	
Calyx-lobes as long as tube. Narrow base of corolla 3 mm. long., 5 mm. broad	*H. diervilloides*, K. Schum.
Calyx-lobes much shorter than tube. Narrow base of corolla 2 mm. long., 1·2 mm broad	*H. sylvestris*, S. Moore.
Corolla silky outside.	
Flowers on pedicels 4–6 mm. long. Calyx-lobes acute. Corolla infundibuliform	*H. Lujæ*, De Wild.
Flowers sessile or almost so. Calyx-lobes acuminate. Corolla campanulate	*H. Brownii*, S. Moore.

CREMASPORA AFRICANA, *Benth. in Hook. Niger Fl.* 412.

Mt. Maruma, 3500 ft.; Chirinda Forest, 3700–4000 ft.; in fl. & fr. Sept., Dec.; nos. 73, 73 *a*, 1285.

Distrib. Tropical Africa.

POLYSPHÆRIA PEDUNCULATA, *K. Schum. in De Wild. Fl. Katanga*, 226 (ex descript.).

Bank of Lower Umswirizwi River, 1000 ft.; Umtefu River, Lower Buzi, 500 ft.; in fl. Jan., Feb.; nos. 74, 1269.

Distrib. Congo Free State.

P. LANCEOLATA, *Hiern, in Oliver, Fl. Trop. Afr.* iii. 128.

Lower Umswirizwi River, 1000 ft.; Boka, Lower Buzi, 100 ft.; open woods at Beira; in fl. Nov., Dec., in fr. Dec.; nos. 1272, 1274, 1274 *a*, 1277.

Distrib. Mozambique, Nyasaland.

PENTANISIA VARIABILIS, *Harv. in Hook. Lond. Journ. Bot.* i. (1842) 22. Var. INTERMEDIA, *Sond. in Harv. Fl. Cap.* iii. 24. In short grass near Chirinda, 3800 ft.; n. 423.

Distrib. Mozambique, Nyasaland, South Africa.

P. SCHWEINFURTHII, *Hiern, in Oliver, Fl. Trop. Afr.* iii. 128.

Melsetter at 6000 ft.; Mt. Pene, 7000 ft.; Northern Melsetter, 5000–6000 ft.; in fl. April, Oct.; nos. 2146, 6103, 6104, 6213.

Distrib. Central Lake region to Rhodesia.

CANTHIUM MICROCODON, *S. Moore*, sp. nov.

Frutex effusus, verisimiliter inermis, ramulis gracilibus ultimis foliosis divaricatis appresse pubescentibus subinde puberulis, foliis brevissime petiolatis parvulis anguste ovato-oblongis acutis basi obtusis subrotundatisve membranaceis supra puberulis subtus præsertim in nervis subpubescentibus

novellis dense et appresse strigoso-pubescentibus costis secundariis utrinque 3–4 paullulum arcuatis facie superiore fere evanidis, stipulis parvulis basi latis inferne connatis subito in acumen breve rigidum exeuntibus extus strigoso-pubescentibus intus glabris, floribus 5-meris pro rata minimis paucis (nonnunquam usque ad 5) ex axillis fasciculatim ortis, pedicellis gracilibus calycem excedentibus pubescentibus, ovario depresse globoso hispidulo calycis limbo campanulato triente inferiore indiviso breviore, calycis lobis anguste lineari-oblongis obtusiusculis, corollæ campanulatæ lobis deltoideis acutiusculis extus pilosis tubo glabro æquilongis, staminibus corollæ faucibus villosis insertis subinclusis antheris ambitu ellipticis apice mucronulatis, stylo subincluso glabro, stigmate subgloboso utrinque truncato longitrorsum sulcato.

Hab. Portuguese East Africa, Madanda forests, at about 400 ft.; in fl. Dec.; n. 552.

Folia 2–3·5 cm. long., 1–2 cm. lat.; petioli 1–2 mm. long. Stipulæ 3 mm. long. Pedicelli summum 3 mm. long. Flores lutescenti-virides. Ovarium 0·6 mm. long. Calycis limbus totus 1·2 mm. long., lobi 0·9 mm. long. Corolla in toto 3 mm. long.; tubus 1·5 mm. long., circa 2 mm. lat.; lobi 1·5 mm. long. Antheræ subsessiles, 0·75 mm. long. Stylus fere 2 mm. long. Stigma $0{\cdot}5 \times 0{\cdot}7$ mm.

Close to *C. telidosma*, S. Moore (*Plectronia telidosma*, K. Schum.), known to me by description alone: this has still smaller leaves, subulate stipules, solitary flowers with even smaller corollas divided only one-third of the way down, and exserted stamens.

Canthium lividum, *Hiern, in Oliver, Fl. Trop. Afr.* iii. 144.

Madanda forests at about 400 ft.; in fl. Dec.; n. 2154.

Distrib. Zambesia.

A large shrub with trailing branches.

Canthium Swynnertonii, *S. Moore*, sp. nov.

Frutex vel arbuscula spinis (anne semper?) alternis patentibus sat validis onustus, ramulis divaricatis subteretibus juvenilibus summum obscure puberulis, foliis petiolatis lanceolatis obtusis basi gradatim angustatis membranaceis utraque facie glabris costis secundariis utrinque 4–5 ad medium vix dichotomis inde cum finitimis arcum valde latum referentibus, stipulis inferne connatis e basi lata subito in acumen breve exeuntibus extus glabris intus basi villosulis, floribus 5-meris parvulis in fasciculis axillaribus paucifloris ordinatis raro pedunculo communi perbrevi suffultis, pedicellis flores excedentibus minute puberulis, ovario subgloboso microscopice puberulo calycis limbum glabrum fere adusque basin in lobos late deltoideos obtusos vel acutiusculos partitum excedente, corollæ faucibus villosis exemptis glabræ tubo urceolari quam lobi lanceolato-oblongi obtusi paullo longiore, staminibus

subexsertis filamentis brevibus antheris ovatis sursum breviter extenuatis, stylo exserto glabro, stigmate mitriformi.

Hab. Chirinda Forest, 3700–4000 ft.; in fl. Nov.; n. 546.

Rami ad nodos compressi aliter subteretes, cortice cinereo circumdati. Spinæ 1- fere 2 cm. long. Folia 4·5–7 cm. long., 1·8–2·5 cm. lat., in sicco facie superiore brunneo- facie inferiore griseo-viridia; petioli 3–6 mm. long. Flores virides. Ovarium 1 mm. long.; calycis limbus 0·4 mm. Corolla tota 4 mm. long.; tubus 2·2 mm. long., inferne 2 mm. faucibus 1·6 mm. lat.; lobi 1·8 mm. long. Filamenta 0·2 mm., antheræ 1 mm. long. Stylus vix 3 mm. long.; stigma 0·5 mm. long., 1 mm. lat.

This has much the look of the South African *Plectronia spinosa*, Klotzsch, among other points of difference being the lanceolate leaves, the smaller ovary and corolla hairy at the throat. From spinous forms of *P. ventosa*, Linn., which it still more closely resembles, it can be easily told by the fasciculate (not corymbose) inflorescences and the smaller flowers with exserted stigma.

CANTHIUM GUEINZII, *Sond. in Linnæa*, xxiii. (1850) 54.

Chipete Forest Patch, Mt. Pene, 7000 ft.; in fl. & fr. April, Oct.; nos. 170, 6101.

Distrib. Natal, Nyasaland, Portuguese East Africa.

Singuni name, "Umhlalel ingonyama" (Await the lion). The slightly astringent black berries are eaten by natives.

CANTHIUM FRANGULA, *S. Moore*, sp. nov.

Frutex grandis, spinis mediocribus armatus, ramis sat validis cortice cinereo obductis ramulos perbreves etsi validos cicatricibus foliorum dilapsorum onustos copiose gignentibus, foliis sub apice ramulorum sitis parvulis petiolis gracilibus fultis ovato-oblongis obtusis sæpe breviter cuspidulatis membranaceis utraque pagina glabris costis secundariis utrinque 4–5 delicatulis arcuato-ascendentibus juxta marginem dichotomis, stipulis caducis inferne connatis lineari-lanceolatis sursum longe acuminatis extus glabris intus basi villosulis, floribus pro rata minimis 5-meris in dichasium simplex abbreviatum racemiforme pauciflorum gracillimum minute puberulum digestis, pedicellis gracillimis ovario turbinato-ovoideo longioribus, calycis limbo quam ovarium breviore in lobos triangulares acutos alte partito glabro, corollæ extus minute puberulæ ultra medium divisæ tubo late cylindrico intus ad os villoso ceteroquin glabro lobis lanceolato-oblongis apice brevissime acuminatis, staminibus corollæ ori insertis antheris subsessilibus breviter exsertis oblongis obtusis, stylo incluso glabro, stigmate mitriformi.

Hab. Madanda forests at about 400 ft.; in fl. Dec.; nos. 1403, 1894.

Rami summum 4 mm. diam., ramuli abbreviati circa 1 cm. long. Folia 1·5–3 cm. long., 8–13 mm. lat., in sicco olivacea vel castaneo-brunnea nec glauca. Stipulæ 2·5 mm. long. Dichasii ramus uterque 8 mm. long.;

circa 4-florus. Pedicelli 1–3 mm. long. Flores luteo-virides. Ovarium 1·2 mm. long., calycis limbus 0·5 mm. Corolla tota 3 mm. long.; tubus 1·15 mm., lobi 1·85 mm. long., ille 2 mm. lat. Antheræ 0·8 mm. long. Stylus 1 mm. long.; stigma 0·4 × 0·6 mm.

To be placed next *C. glaucum*, Hiern, the chief differences being the not glaucous leaves, the simple inflorescences, longer ovary, larger calyx-lobes, corolla with shorter tube and longer and relatively narrower lobes not obtuse at the end, larger anthers and shorter style.

CANTHIUM MUNDTIANUM, *Cham. & Schlecht. in Linnæa*, iv. (1829) 131.

Mt. Umtereni, 4000 ft.; in. fl. Sept.; n. 644. Chindao name, "Mugarandjerere" (Kite's perch).

Distrib. Natal, Transvaal.

A small tree with a straight sapling-like growth. The wood is extremely durable and resists white ants and borers.

CANTHIUM RACEMULOSUM, *S. Moore*, sp. nov.

Frutex amplus, inermis ramulis divaricatis subteretibus cortice cinereo obductis ultimis foliosis glabris, foliis petiolatis obovatis acutis breviterve cuspidulato-acuminatis basi rotundatis vel obtusis membranaceis supra glabris subtus minutissime puberulis costis secundariis utrinque 5–6 juxta marginem irregulariter arcuatis, stipulis cito dehiscentibus inferne connatis e basi lata sensim angustatis sursum linearibus extus glabris intus basi fulvo- vel stramineo-villosis, floribus parvis 5-meris in paniculas sessiles breviterve pedunculatas quam folia multo breviores e racemulis paucis compositas leviterque puberulas digestis, ovario ovoideo quam calycis limbus brevissimus subtruncatus longiore, corollæ extus microscopice puberulæ tubo late cylindrico intus ad os ipsum villoso lobis triangulari-oblongis apice acutis necnon brevissime barbellatis tubo æquilongis, antheris corollæ ori affixis subsessilibus subinclusis ovato-oblongis obtusis, disco puberulo, stylo breviter exserto, stigmate mitriformi longitrorsum sulcato.

Hab. Madanda forests at about 400 ft.; in fl. & fr. Dec.; n. 541.

Folia 4–8 cm. long., 2·5–4·5 cm. lat., in sicco castanea; petioli circa 5 mm. long., facie superiore canaliculati. Stipulæ 7–11 mm. long., harum basis 2·5–3 mm., pars linearis 4·5–8 cm. long. Flores virides. Pedicelli 1–2 mm. long., puberuli. Ovarium 1·25 mm., calycis limbus 0·25 mm. long. Corolla tota 5 mm. long. Antheræ 1·25 mm. long. Stylus 3 mm. long. Stigma 0·75 × 0·6 mm. Bacca cruda e coccis duobus sæpissime imparibus sistens, siccitate nigrescens, 3 × 2·5–3 mm.

Differs from *C. gracile*, Hiern, for which it might be mistaken on a first view, chiefly in the broader leaves, the smaller flowers with corollas hairy at the mouth itself instead of a short way down the tube, the smaller obtuse anthers, and the shorter style.

CANTHIUM VENTOSUM, *S. Moore*, comb. nov.
Plectronia ventosa, Linn. Mant. 52.
In open, short grass-veld on Mt. Pene at 6500 ft.; in fl. Sept.; n. 547.
Distrib. South Africa.

VANGUERIA INFAUSTA, *Burch. Trav.* ii. 258.
Near Chirinda; Chikore Hills; Madanda forests; Umhlonhlo, Lower Buzi; in fl. Oct.–Dec.; nos. 63, 1290, 1291, 1292. Chindao name, "Munjiro."
Distrib. Tropical and S. Africa.

V. EDULIS, *Vahl, Symb.* iii. (1794) 36.
Chibabava, Lower Buzi; in fl. Dec.; n. 540. Chindao name, "Munjiro."
Distrib. Tropical Africa, Madagascar; also East Indies, where probably introduced.

VANGUERIA ESCULENTA, *S. Moore*, sp. nov.
Frutex elatus vel arbuscula ramulis sat attenuatis patentibus rigidis cortice subfusco obductis ultimis paucifoliatis diutule pubescentibus, foliis parvulis brevipetiolatis lanceolatis vel lanceolato-ovatis sursum attenuatis apice obtusis basi rotundatis membranaceis utraque facie præsertim vero in nervis fulvo-pubescentibus costis secundariis utrinque circa 6 aperte arcuatis, stipulis e basi lata linearibus acutis pubescentibus, floribus pro rata mediocribus in cymas paucifloras sat longas præcipue ex axillis jam defoliatis ortis digestis, calycis tubo (ovario) hemisphærico puberulo limbo æquilongo limbo in lobos 4 vel 5 triangulares obtusos acutosve alte diviso obscure puberulo, corollæ tubo calycem plane excedente etsi brevi cylindrico sub limbo puberulo ore villosulo lobis 4 vel 5 tubo brevioribus oblongis acutis extus puberulis, antheris ori corollæ affixis breviter exsertis apice acutis, ovario 4–5-loculari, stylo breviter exserto, stigmate cylindraceo-capitato.
Hab. Chirinda Forest, 3700–4000 ft.; fl. Sept., Oct.; n. 65.
Folia 3–4 (raro 5) cm. long., 1·2–2 (raro 2·5) cm. lat., in sicco viridia, subtus parum pallidiora; petioli 4–5 mm. long., fulvo-pubescentes. Stipulæ circa 4 mm. long. Cymæ sæpissime 1–1·5 cm. long., pubescentes. Bracteæ ovatæ, circa 1·5 mm. long. Ovarium 1·2 mm. long., calycis lobi 1 mm. Corollæ tubus humectatus 4 mm. long., vix totidem lat.; lobi 3 mm. long. Filamenta 0·5 mm., antheræ 1·75 mm. long. Discus maxime eminens. Stylus compressus, superne angustatus, glaber, 6 mm. long.; stigma 0·6 mm. long.
Near *V. edulis*, Vahl, and *V. infausta*, Burch., but different from both in foliage and various floral details. The fruit, which is edible, is known as the "Chirinda Medlar." This is the common "Munjiro" of the forest; the bright gamboge fruits fall from the trees in March and April.

Var. GLABRA, *S. Moore*, var. nov. Folia glabra. Cymæ summum puberulæ.
Hab. Chirinda Forest; in fl. Dec.; n. 1307.

VANGUERIA MUNJIRO, *S. Moore*, sp. nov.

Frutex grandis, inermis, ramulos sat validos nudos juveniles breviores foliosos dense pubescentes emittens, foliis brevipetiolatis oblongo-obovatis obtusis vel obtusissimis basi cuneatim angustatis membranaceis utrobique sed præsertim subtus molliter pubescentibus (novellis fulvo-tomentellis) costis secundariis utrinque 8 patule ascendentibus aperte arcuatis, stipulis linearibus pubescentibus diutule persistentibus, floribus mediocribus in cymulas paniculatas brevipedunculatas quam folia breviores pubescentes digestis, ovario depresse globoso quam pedicelli nunc longiore nunc breviore ut limbus in lobos 5 triangulares obtusos obtusiusculosve alte partitus dense pubescente, corollæ pubescentis tubo late cylindrico quam lobi 5 oblongo-lanceolati apice acuminati paullulum breviore faucibus villoso, staminibus subinclusis filamentis faucibus insertis quam antheræ apice apiculatæ paullo brevioribus, stylo breviter exserto crassiusculo superne paullulum attenuato puberulo, stigmate pileato.

Hab. Kurumadzi River, Jihu, at 2000 ft. ; fl. Nov. ; n. 1293.

Folia majora 9–10 × 4·5–5 cm., minora 3·5–6 × 2–3 cm., basi sæpe parum obliqua ; costæ supra planæ subtus leviter prominulæ ; petioli circa 5 mm. long., dense pubescentes. Stipulæ circa 6 mm. long. Paniculæ 3–4 cm. long., 3–6 cm. diam. Flores virides. Ovarium 1·5 mm., calycis limbus 1 mm. long. Corolla 7·5 mm. long. ; tubus 3·5 mm. long., 2·5 mm. diam. ; lobi 4 mm. long., mox reflexi. Filamenta 1 mm. long., antheræ 1·6 mm. Stylus ægre 5 mm. long., stigma 0·13 mm.

A plant of familiar appearance, which I have been unable to match either from specimens or descriptions. Small-leaved forms of *V. infausta*, Burch., might be mistaken for it, but the acuminate corolla-lobes of *V. Munjiro* afford an easy means of discriminating between the two. *V. Volkensii*, K. Schum., with much the same foliage has different stipules and larger corollas with a glabrous tube and still more acuminate lobes.

This is the common "Munjiro" of the Jihu. There is another specimen of it in the British Museum from Victoria, Rhodesia (*Monro*, 605 A).

VANGUERIA SPARSIFOLIA, *S. Moore*, sp. nov.

Frutex elatus, inermis, copiose ramulosus, glaber, ramulis attenuatis maxime divaricatis infra apicem solummodo foliosis, foliis parvis anguste ovato-oblongis raro anguste obovatis sursum gradatim attenuatis apice obtusis vel obtusissimis nonnunquam emarginatis basi in petiolum brevem angustatis membranaceis costarum axillis pubescentibus exemptis glabris costis secundariis utrinque 4 ascendentibus parum perspicuis, stipulis ima basi latis ibique connatis necnon intus villosulis inde subito in appendicem linearem glabram exeuntibus, floribus 5-meris parvulis in cymas umbelliformes breviter pedunculatas 2–4-floras glabras dispositis, pedicellis ovarium excedentibus, ovario subgloboso calycis limbum brevem dentatum excedente 3–4-loculari, corollæ tubo cylindrico quam lobi lanceolato-oblongi obtusi plane

breviore intus ore villoso ceterum glabro, staminibus ori insertis antheris breviter exsertis subsessilibus ovatis apice apiculatis basi sagittulatis, stylo inferne crassiusculo sursum attenuato glabro, stigmate subexserto cylindrico utrinque truncato longitrorsum sulcato.

Hab. Madanda forests at about 400 ft.; fl. Dec.; n. 551.

Folia 2·5–4 (raro 5) cm. long., 1·2–2 cm. lat., in sicco utrinsecus præsertim vero pagina superiore viridia; petioli circa 2 mm. long. Stipulæ circa 3 mm. long. Pedunculi 1–3 mm. long. Pedicelli filiformes, 2–4 mm. long. Flores lutescenti-virides. Ovarium 1·5 mm., calycis limbus ·5 mm. long. Corolla in toto 5·5 mm. long.; tubus 2 mm., lobi 3·5 mm. long. Antheræ 1·8–2 mm. long. Stylus 2·5 mm. long.; stigma 1 mm. long.

The affinity of this is with *V. canthioides*, Benth., which has larger leaves, hairy pedicels and calyx, a corolla with a tube longer than the lobes, different anthers and a longer style.

VANGUERIA APICULATA, *K. Schum. in Engl. Pflanzenw. Ost-Afr.* C. 384.

Common in long grass on the outskirts of Chirinda Forest; in fl. Dec.; n. 64. "Small wild Medlar"; Chindao name, "Munjiro."

Distrib. Tropical East Africa, northwards to Uganda.

VANGUERIA DRYADUM, *S. Moore*, sp. nov.

Frutex scandens, ramis gracilibus foliis jam orbis teretibus ut ramuli patentissimi foliosi pubescentibus deinde glabris et cortice fusco-purpureo obductis novellis dense pubescentibus, foliis parvulis brevipetiolatis ovato- vel lanceolato-oblongis obtusis obtusissimisve basi obtusis nonnunquam subrotundatis subcoriaceis utrinque velutinis, stipulis minutis lineari-subulatis pubescentibus brunneis, floribus mediocribus in foliorum axillis ramulorum brevium ultimorum solitariis pedunculis sat longis suffultis, ovario subgloboso ut pedunculi et calyx alte 5-partitus dense subfulvide sericeo 5-loculari, calycis lobis oblongo-oblanceolatis obtusis ovarium multo excedentibus, corollæ extus pubescentis tubo calyce paullo breviore subcylindrico (medio paullulum ampliato) ore villoso intus infra medium pilorum annulo onusto lobis 5 lineari-lanceolatis acuminatis tubum leviter excedentibus, staminibus faucibus affixis breviter exsertis antheris anguste ovoideo-oblongis acutis, stylo exserto superne attenuato glabro, stigmate cylindraceo apice convexo basi truncato 5-sulcato.

Hab. Madanda forests at about 400 ft.; fl. Dec.; n. 1030.

Folia vulgo 1·5–2·5 cm. long. (raro 2·5 cm.), 7–12 mm. lat., pagina inferiore grisea, pagina superiore griseo-olivacea; costæ secundariæ utrinque 2–3, teneræ. Stipulæ circa 2 mm. long. Pedunculi 1·5 cm. attingentes, sæpe vero breviores. Flores dilute virides. Ovarium 2·5 × 2·5 mm. Calycis lobi 9–10 mm. long., sursum 4 mm. lat. Corollæ tubus 6 × 3 mm.; lobi 7 mm. long. Filamenta tenuia, 1 mm. long., antheræ 1·5 mm. Stylus 1·25 cm. long.

In foliage much like *V. macrocalyx*, Sond., but in habit more slender than that, with much longer pedicels to the flowers, broader calyx-lobes, corolla with the lobes longer and differently shaped, &c.

FADOGIA CIENKOWSKII, *Schweinf. Rel. Kotsch.* 47.

Chirinda Forest and Mt. Pene; in fl. Sept., Oct., Dec.; nos. 241, 6122, 6502. Flowers very attractive to sun-birds (*Cyanomitra olivacea*) and to butterflies, especially *Papilio polixenes* and *P. angolensis*.

Distrib. African tropics, Transvaal.

CRATERISPERMUM LAURINUM, *Benth. in Hook. Niger Fl.* 411.

Near Chirinda; Mt. Umterani at 4000 ft.; open woods at Beira; in fl. Oct., fr. Dec.; nos. 183, 1069, 1070.

Distrib. West and South tropical Africa.

COFFEA (§ Exsertæ: Perennes) LIGUSTROIDES, *S. Moore*, sp. nov.

Fruticosa, glabra, novellis aliquanto resinosis, ramulis gracilibus leviter compressiusculis mox teretibus crebro foliosis, foliis oblongo-lanceolatis sæpissime cuspidulatis apice obtusis basin versus in petiolum brevem attenuatis tenuiter coriaceis costis secundariis utrinque circa 8 patulis parum arcuatis, stipulis a basi lata in acumen sat longum sensim abeuntibus, floribus in axillis solitariis pedunculis quam ovarium plane longioribus fultis, calyculo duplici a flore subremoto ore lobato vel subtruncato, ovario anguste ovoideo, calycis limbo obsoleto, corollæ 4-meræ tubo infundibulari lobis ovato-oblongis obtusis quam tubus paullulum longioribus, staminibus 4 filamentis brevibus antheris exsertis lineari-oblongis obtusis, styli exserti ramis linearibus, ovulo medio septo affixo, bacca oblonga exsucca 1-sperma.

Hab. Chipete Forest Patch, 3800 ft.; in fl. Dec., ripe fr. July; n. 67.

Foliorum limbus glandulis pellucidis minutissimis copiosissime præditus, solemniter 5–7 cm. long. et 1·5–2 cm. lat., facie superiore in sicco olivaceo-fuscus, facie inferiore viridis; costæ superne subplanæ inferne eminentes. Stipulæ circa 4–5 mm. long. Pedunculi adusque 4 mm. long. Flores albi. Ovarium 1·5 mm. long. Corollæ tubus 5 mm. long., basi 1·5 mm. faucibus 3 mm. diam.; lobi 6 mm. long. Filamenta crassiuscula, 1 mm. long., antheræ 4 mm. Stylus 7 mm. long., ejus rami capitulati, 2 mm. long. Bacca ex schedis cl. detectoris flava, circa 1 cm. long. et 7 mm. lat. Semina 7·5 mm. long.

Known readily from allied species by the small leaves and tetramerous flowers.

"This is the shrub yielding Chirinda coffee; it forms the main undergrowth of the Chipete Forest Patch. The crop is always small though heavier in alternate years, the dense shade under which most of it grows being prejudicial to heavy cropping. The berries are greatly eaten by the forest bulbuls and robins as well as by baboons. The larvæ of a large white and brown longicorn beetle (*Anthores leuconotus*) destroy this shrub, entering

just above the ground and completely eating out the root and base of the trunk."

Coffea (§ Exsertæ: Perennes) Swynnertonii, *S. Moore*, sp. nov.

Frutex ramulis superne foliosis teretibus cito fere glabris (novellis viscidis) cortice cinereo transversim rupto circumdatis, foliis parvis oblongis vel oblongo-lanceolatis obtusis basi in petiolum brevem attenuatis tenuiter coriaceis utrobique fere omnino glabris costis secundariis utrinque 4–5 inferioribus ascendenti-arcuatis superioribus patentibus costa marginali a margine satis distante anfractuoso, stipulis a basi lata subulatis rigidis, floribus iisdem temporibus ac folia genitis in axillis sæpius 2–4 breviter pedunculatis, calyculo simplici pedunculo inserto ore dentato, ovario ut calyculus calyxque secremento viscido obducto hemisphærico, calycis limbo brevissimo obscure denticulato, corollæ glabræ tubo infundibulari lobis 8–9 anguste ovato-oblongis obtusis quam tubus paullo longioribus, staminibus 8–9 exsertis filamentis quam antheræ fere 4-plo brevioribus antheris oblongis obtusis, styli exserti ramis elongatis linearibus, bacca anguste ovoideo-oblonga exsucca disperma.

Hab. Near Chirinda under cultivation at 3000 ft.; Madanda forests at about 400 ft.; fl. Oct., fr. Dec.; nos. 578, 2133.

Folia summum 3·5 × 1·2 cm., modica 2·5 × 1 cm., pag. sup. punctis albis microscopicis copiosissime induta, in sicco supra subolivacea vel brunnea, subtus pallidiora; petioli circa 2 mm. long. Stipulæ 2–2·5 mm. long. Pedunculi 1·5–2 mm. long. Calyculus vix 1 mm. long. Flores albi. Ovarium 1 mm. long. Calycis limbus 0·3 mm. long. Corollæ tubus 7 mm. long., basi 1·5 mm., faucibus 4·5 mm. lat.; lobi summum 9 mm. long. Filamenta 1·5 mm., antheræ 5–6 mm. long. Stylus 11 mm. long.; stigmatis rami 5 mm. Bacca 9 mm. long., 6·5 mm. lat. Semina 5·5 mm. long., fusco-grisea.

To be inserted next *C. stenophylla*, G. Don, from which it differs chiefly in the much smaller not caudate-acuminate leaves, the short stipules, the short-toothed calyculus, and the smaller berries and seeds.

N. 2133 is the plant in flower; n. 578 is surmised by Mr. Swynnerton, and I believe correctly, to be the fruiting state. N. 579 (in fruit) from Malata near the mouth of the Buzi (the "Inyambane coffee" of settlers) may perhaps be a form of the same with somewhat larger leaves (up to 4·5 × 2 cm.).

"This coffee grows wild in quantities on the Juababa River, Portuguese E. Africa, at about 1000 ft. Seed brought thence a few years ago." The coffee yielded by these berries is said to be of excellent quality.

Pavetta gracillima, *S. Moore*, sp. nov.

Fruticulus ramis tenuibus teretibus nudis cortice albo circumdatis ramulos gracillimos apice foliosos minute puberulos dein glabros gignentibus,

foliis parvulis oblanceolatis vel oblanceolato-oblongis apice obtusis obtusissimisve nunc brevissime cuspidulatis inferne in petiolum brevem sensim contractis tenuiter membranaceis supra scabriusculis subtus præsertim in nervis puberulis costis secundariis utrinque 5–6 ascendentibus juxta marginem ipsum solummodo arcuatis utraque facie parum aspectabilibus, stipulis ima basi connatis parvulis deorsum latis sursum in acumen breve rigidum exeuntibus intus villosulis diutius persistentibus, floribus submediocribus 4-meris in paniculis terminalibus perbrevibus subumbellatis griseo-pubescentibus pluri-floris dispositis, pedicellis calyces subæquantibus, ovario calycis limbo breviore oblongo-ovoideo griseo-pubescente, calycis pubescentis limbo in lobos 4 anguste lineari-lanceolatos acuminatos alte partito, corollæ tubo calycis limbum triplo excedente extus glabro intus juxta fauces pilosulo lobis oblongo-lanceolatis acutis quam tubus manifeste brevioribus, staminibus exsertis corollæ ori affixis, stylo longe exserto sursum minutissime puberulo, stigmate clavellato integro papilloso.

Hab. Madanda forests at about 400 ft.; in fl. Dec.; n. 1260 *a*.

Folia 3·5–4 cm. long., 1·3–2 cm. lat., in sicco griseo-viridia; petioli summum 5 mm. long. sed plerumque breviores; stipulæ circa 2–3 mm. long. Inflorescentiæ circa 3 cm. diam., floribus exemptis summum 5 mm. long. sed plerumque breviores. Pedicelli plerique 3–4 mm. long. Flores albi. Ovarium 1·2 mm. long., calycis limbus 4·5 mm. Corollæ tubus 1·3 cm. long., humectatus inferne 0·7 mm. superne 1·3 mm. lat.; lobi 5 mm. long. Antheræ anguste lineares, acutæ, 4 mm. long. Stylus 2·8 cm., stigma 2 mm. long.

Differs from *P. Klotzschiana*, K. Schum., chiefly in the longer pedicels, the smaller and narrower lobes of the calyx, and the slender tube of the corolla.

PAVETTA KLOTZSCHIANA, *K. Schum. in Engl. Pflanzenw. Ost-Afr.* C. 388.

Madanda forests at about 400 ft.; Lower Buzi; in fl. Dec.; nos. 1259, 1260. Shrub with white flowers; on limestone.

Distrib. Nyasaland and Mozambique.

PAVETTA BUZICA, *S. Moore*, sp. nov.

Fruticosa, glabra, ramulis gracillimis cortice albido mox obductis apice foliosis, foliis parvulis subsessilibus oblanceolatis apice ipso acutis vel obtusiusculis nonnunquam brevissime cuspidulatis inferne gradatim extenuatis tenuiter membranaceis in sicco griseo-viridibus costis secundariis utrinque 4–5 ascendentibus, stipulis parvulis connatis ovatis acuminatis apice rigidis intus villosulis, floribus 4-meris ad normam generis parvis in paniculas terminales abbreviatas dispositis, pedicellis calycem circa semiæquantibus, ovario subgloboso quam calycis limbus in lobos 4 anguste lineari-lanceolatos acuminatos alte partitus multo breviore, corollæ tubo calycis limbum plus quam duplo superante lobis lanceolato-oblongis acutis tubum fere semiæquantibus,

staminibus exsertis corollæ ori affixis antheris anguste linearibus apiculatis, stylo longe exserto apice clavellato.

Hab. Umhlonhlo, Lower Buzi ; in fl. Jan. ; n. 1259 *a*.

Folia 2·5–5 × ·5–1·8 cm. ; petioli summum 3 mm. long., sæpe vero breviores nisi evanidi. Stipulæ 2–4 mm. long. Inflorescentiæ circa 1·5 cm. diam., corollis exclusis modo 5 mm. long. Flores albi. Pedicelli ± 2 mm. long. Ovarium 0·65 mm., calycis limbus vix 4 mm. long. Corollæ tubus inferne intus puberulus 9 mm. long., inferne 0·6 mm. superne 1 mm. lat. ; lobi 4 mm. long. Antheræ subsessiles 4 mm. long. Stylus 2 cm. long., stigma 1·5 mm.

Near *P. gracillima*, described above, from which it differs in the absence of a hairy covering, in the somewhat smaller leaves, the shorter pedicels, globose ovary, and corollas with a shorter tube and shorter and narrower lobes.

PAVETTA STIPULOPALLIUM, *K. Schum. in Warb. Kunene-Samb. Exped.* 393.

Nyahodi River at 5000 ft. ; in ft. April ; n. 2147.

Distrib. Angola, Rhodesia.

P. SCHUMANNIANA, *K. Hoffm. ex K. Schum. in Pflanzenw. Ost-Afr.* C. 389.

Chikore Hills, 3500 ft. ; in fl. Nov. ; n. 1212.

Distrib. Angola to Eastern tropical Africa.

PAVETTA ALBICAULIS, *S. Moore*, sp. nov.

Fruticosa, ramis validis nodosis stipularum diu persistentium reliquiis onustis glabratis albis novellis griseo-velutinis, foliis apicem versus ramulorum juniorum congestis obovato-oblongis sursum angustatis obtusis basi in petiolum brevemgradatim desinentibus firme membranaceis supra hispidulo-pubescentibus subtus griseo-velutinis costis secundariis utrinque circa 12 patentibus leviter arcuatis, stipulis basi vaginatim connatis ovatis caudato-acuminatis extus griseo-velutinis, floribus mediocribus pedicellatis in axillis ramorum jam foliis orborum dense cymosis tetrameris, ovario subsphæroideo ut pedicelli calycisque limbus pubescente, calycis parvuli limbo circa medium usque in lobos triangulares obtusos diviso, corollæ tubo calycem multoties excedente superne amplificato glabro (intus vix omnino glabro) lobis oblongis obtusissimis tubo multo brevioribus, stylo longe exserto apice clavellato.

Hab. Open woods at Beira ; in fl. Dec. ; n. 1261.

Rami florigeri 3–4 mm. diam., cortice coriaceo albo nullo negotio separabili circumdati ; internodia solemniter circa 2 cm. long. Folia ± 6 cm. long., 2–3 cm. lat. ; petioli 5 mm. long., vel etiam minus. Stipulæ 7 mm. long. Cymæ sessiles, multifloræ. Pedicelli circa 7 mm. long., pubescentes. Flores albi. Ovarium 1·2 mm. long., calyx totidem. Corollæ tubus 15 mm. long.,

inferne 0·75 mm., superne 1·5 mm. diam.; lobi 4·5 mm. long. Stylus 30 mm. long.

Allied to *P. Schumanniana*, F. Hoffm., but different in the long pedicels and in the corolla.

Pavetta comostyla, *S. Moore*, sp. nov.

Fruticosa, ramis defoliatis cortice dilute brunneo obductis ramulos breves foliosos glabros apicem versus emittentibus, foliis ovatis obovatisve breviter cuspidatis apice obtusis basi in petiolum manifestum cuneatim angustatis membranaceis utraque facie glabris margine obscure denticulatis denticulis ciliolatis in sicco nigrescentibus subtus lividis costis secundariis utrinque circa 8 ascendentibus paullulum arcuatis; stipulis late ovatis acutis intus hirsutis diuscule persistentibus, floribus in corymbum brevem glabrum foliis breviorem congestis, bracteis minutis setaceis, floribus 4-meris, calycis tubo (ovario) pedicello breviore hemisphærico limbo tubum bene excedente alte lobato lobis linearibus acutis extus puberulis, corollæ tubo gracili calycem magnopere superante extus glabro intus piloso lobis tubo triplo brevioribus, antheris sessilibus exsertis, stylo longissimo glabro, stigmate parum incrassato integro.

Hab. Chirinda Forest, 3700–4000 ft.; in fl. Jan.; n. 75.

A large shrub not uncommon in Chirinda, where its masses of white panicles make a great show during January.

Foliorum limbus 7–9 × 4–5·5 cm.; petioli circa 1 cm. long. Stipulæ 5 mm. long. Corymbi 4 × 6 cm. Pedicelli ± 3 mm. long. Flores albi. Calycis tubus 1·2 mm., limbus 5 mm. long., hujus lobi 4 mm. Corollæ tubus 1·8–2 cm. long., inferne 1·5 mm. superne 2 mm. diam.; lobi anguste oblongo-obovati, acutiusculi, 6 mm. long., crassiusculi. Antheræ 5·5 mm. long. Stylus modo non 5 cm. long.; stigma 2 mm. long.

This has some resemblance to *P. angolense*, Hiern, but among other features its leaves are smaller and differently shaped, and the calyx-lobes are shorter and not setaceous.

Pavetta saligna, *S. Moore*, sp. nov.

Frutex grandis, crebro ramulosus, glaber, ramulis tenuibus cito cortice cinereo circumdatis ad nodos aliquantulum tumidis, foliis lineari- vel oblongo-lanceolatis sursum gradatim extenuatis apice obtusis basi in petiolum brevem cuneatim coartatis tenuiter coriaceis in sicco olivaceo-fuscescentibus supra nitidulis costis secundariis utrinque 6–7 ascendentibus marginem versus dichotomis, stipulis parvulis diu persistentibus ovatis obtusiusculis firmis extus glabris intus appresse pubescentibus, floribus 4-meris pro rata parvis in paniculas terminales paucifloras a foliis superatas digestis, pedicellis ovarium longe excedentibus, ovario turbinato quam calycis limbus cupuliformis ore denticulatus paullulum breviore, corollæ tubo calycis limbum duplo

excedente stricte cylindrico quam lobi ovato-oblongi obtusi vel emarginati breviore intus faucibus villoso, staminibus exsertis antheris lineari-oblongis breviter apiculatis, stylo subincluso sursum incrassato ibidemque villosulo stigmati anguste fusiformi acuto obscure puberulo æquilongo.

Hab. Lower Buzi, Chironda and Boka; in fl. Dec.; nos. 1262, 1263.

Folia solemniter 5–10 cm. long., 1–2·7 cm. lat.; costularum rete sublaxum, modice perspicuum; petioli sat validi, 3–6 mm. long. Stipulæ 2 mm. long. Corymbi 3–4 cm. long., et totidem diam. Pedicelli circa 1 cm. long. Flores albi. Ovarium 1·5 mm. long., calycis limbus 2 mm. Corolla in toto 1 cm. long.; tubus 4 mm. long., 1·3 mm. diam.; lobi 6 mm. long. Stylus 5·5 mm. long., stigma 5·5 mm.

Near *P. neurophylla*, S. Moore, but, among other features, the leaves are shorter in the petiole and in texture thinner; the cupular calyx is quite different, and the tube of the corolla much shorter and broader.

PAVETTA SWYNNERTONII, *S. Moore*, sp. nov.

Arbuscula vel frutex elatus, ramulis subteretibus ultimis foliosis una cum novellis glabris, foliis lanceolatis vel oblanceolato-oblongis sæpius cuspidato- vel caudato-acuminatis apice obtusis basi in petiolum sat longum gradatim attenuatis utrinque glabris tenuiter coriaceis in sicco nigrescentibus nitidis costis secundariis 7–8 parum arcuatis supra impressis subtus eminentibus utrinque percursis, stipulis e basi lata rigida subulato-setaceis diu persistentibus extus glabris intus pubescentibus, corymbis breviusculis plurifloris terminalibus necnon ex axillis summis oriundis foliis æquilongis vel brevioribus, bracteis subulatis quam pedicelli pubescentes brevioribus, floribus 5-meris, calycis tubo (ovario) parvo subhemisphærico limbo brevi ad ½ lobato pubescente hujus lobis triangularibus obtusis, corollæ extus glabræ intus pubescentis tubo calycis limbum 5-plo excedente limbo tubum æquante lobis oblongis obtusissimis, antheris subsessilibus exsertis, stylo exserto inferne filiformi et glabro in medio incrassato et pubescente, stigmate clavato integro.

Hab. Chirinda Forest, at 3700–4000 feet; in fl. Jan.; n. 117.

Folia 8–14 cm. long., 3–5 cm. lat., summa minora, e. g. 5 × 2·5 cm.; petioli 1–2 cm. long. Stipulæ 6 mm. long. Corymbi 6–8 cm. long., circiter totidem diam. Bracteæ ultimæ 1 mm., pedicelli circa 2 mm. long. Flores albi. Ovarium 1·2 mm. long. Calycis limbus in toto 1·2 mm., lobi 0·5 mm. long. Corollæ tubus 6 mm. long., humectatus 1·5–1·8 mm. diam.; limbi lobi crassiusculi, 2 mm. lat. Antheræ apice mucronulatæ, 5 mm. long. Stylus vix 1 cm., stigma 3 mm. long. Baccæ nitentes, glabræ, 5 mm. diam.

This also is near *P. neurophylla*, but the leaves and calyces are quite different.

PSYCHOTRIA BUZICA, *S. Moore*, sp. nov.

Frutex altitudinis mediocris, ramulis teretibus cortice aloido obductis novellis compressis puberulis mox glabris, foliis oppositis vel ternis lanceolato-oblongis vel anguste oblongo-obovatis obtusis basin versus in petiolum brevem angustatis papyraceis glabris vel summum leviter puberulis plus minus præsertim pagina inferiore griseo-viridibus costis secundariis utrinque 5 late arcuatis facie inferiore solum prominulis, stipulis ima basi connatis ovatis sursum bifidis extus puberulis intus pubescentibus segmentis aristiformibus sæpe leviter recurvis, floribus pro rata mediocribus 5–6-meris heterostylis in umbellas terminales pedunculatas paucifloras digestis, pedunculis gracilibus quam folia brevioribus puberulis vel glabris, bracteis perpaucis parvulis, pedicellis floribus subæquilongis brevioribusve, calycis tubo (ovario) subhemisphærico limbo cyathiformi ore denticulato æquilongo, corollæ paullo ultra medium divisæ extus glabræ tubo cylindrico faucibus villoso lobis oblongis obtusis apice incrassatis dein reflexis, staminibus paullulum infra loborum sinus insertis nunc inclusis nunc exsertis filamentis florum macrostylorum valde abbreviatis, antheris lineari oblongis obtusis, stylo incluso vel exserto superne incrassato ramis 2 obovatis obtusissimis terminato.

Hab. Madanda forests at about 400 ft.; Boka, Lower Buzi, 100 ft.; in fl. Dec.; nos. 562, 562 *a*.

Folia pleraque 5–6 cm. long., 2–3 cm. lat.; petioli summum 5 mm. long. Stipulæ circa 3–4·5 mm. long., harum segmenta 1·5–2 mm. long., omnes membrana intermedia tenui albida instructæ. Pedunculi usque ad 3·5 cm. long., sæpe vero breviores. Pedicelli ± 3 mm. long. Flores albi. Ovarium 1·25 mm. long. Corolla 6·5 mm. long.; tubus 3 mm., lobi 3·5 mm. long. Filamenta florum aliorum 0·4 mm. long., aliorum 2 mm.; antheræ 1·5 mm. long. Stylus nunc 6 mm. long., nunc ad 3 mm. redactus; rami 0·6 mm. long.

To be inserted near *P. pumila*, Hiern, which has broader leaves, longer stipules, ebracteate umbels on short peduncles, ovate corolla-lobes, a bidentate style, &c. Probably to be referred here, though the leaves are more hairy (the flowers are still in bud), is another Madanda specimen (n. 1899).

PSYCHOTRIA MADANDENSIS, *S. Moore*, sp. nov.

Fruticosa ramis teretibus cortice albo circumdatis ad nodos prominenter cicacitriferis novellis sub lente puberulis, foliis 2–4-nis petiolatis oblanceolatis vel lanceolato-linearibus acutis basi sensim coartatis papyraceis costarum axillis facie inferiore pubescentibus exemptis glabris in sicco olivaceis subtus pallidioribus costis secundariis utrinque 5 ascendenti-arcuatis, stipulis connatis parvulis ovatis bifidis segmentis aristiformibus, floribus submediocribus in paniculas terminales pedunculatas abbreviatas perpauciramosas obscure bracteatis dispositis sæpe ad merum umbellum redactis, pedunculis gracilibus quam folia manifeste brevioribus, pedicellis crassiusculis quam flores brevioribus, calycis tubo (ovario) oblongo-turbinato limbo cupulari ore minute denticulato

æquilongo, corollæ 5-meræ extus glabræ tubo cylindrico inferne costato faucibus villoso lobos oblongos acutos paullulum excedente, staminibus exsertis filamentis juxta medium tubum insertis antheris oblongis obtusis, stylo incluso sursum levissime incrassato glabro ramis obovatis cristulatis coronato.

Hab. Madanda forests, at about 400 ft.; in fl. Dec.; n. 561.

Folia 5·5–7 cm. long., 1·5–2·8 cm. lat.; petioli 2–7 mm. long. Stipulæ 2 mm. long. Pedunculi 2 cm. attingentes, sed sæpe breviores. Pedicelli 1·5 mm. long. Ovarium 1 mm., calycis limbus 1 mm. long. Flores albi. Corolla in toto 4·5 mm. long.; tubus 2·5 mm. long. Filamenta 1·7 mm. long. Stylus ægre 1·5 mm. long., hujus rami 0·6 mm. long. Bacca ovoidea, in sicco 9×5 mm.

Near the last, from which it differs in the leaves, the small stipules, the often paniculate inflorescences, and various details of the smaller flowers. Judging from the description and figure in Ann. Mus. Congo, ii. 180, t. xlii., the affinity is also with *P. Butayei*, De Wild.

GRUMILEA PUNICEA, *S. Moore*, sp. nov.

Frutex grandis, ramulis subtetragonis crebro foliosis inferne cicatricibus foliorum dilapsorum prominentibus ornatis ab initio glabris, foliis oblongo-oblanceolatis vel oblongo-ovatis obovatisve apice obtusis basi in petiolum brevem cuneatim angustatis coriaceis utrobique glabris vel pagina inferiore in nervis nervulisque piloso-puberulis costis secundariis utrinque 9–10 costæ centrali varie insertis leviter arcuatis axillis domatiis parvis instructis, stipulis mox dehiscentibus parvis inter se liberis ovatis superne angustatis bifidis apicibus acuminatis extus fere omnino glabris intus appresse fulvo-villosis, cymis foliis brevioribus sæpissime trifurcatis plurifloris puberulis, bracteis brevissimis necnon obtusissimis pilis aliquanto subramentaceis fulvis indutis, floribus sessilibus extus leviter puberulis, calycis tubo (ovario) obovoideo-turbinato quam limbus undulatus 5-lobatusve longiore, corollæ adusque $\frac{1}{3}$ divisæ tubo superne leviter ampliato intus dimidio superiore villoso limbi lobis ovato-oblongis obtusiusculis subinde reflexis, staminibus breviter exsertis, stylo incluso glabro, bacca nondum matura subsphæroidea obscure puberula.

Hab. Chimanimani Mountains at 7000 ft.; in fl. and fr. (unripe) Sept.; n. 563.

Folia 5–10 cm. long., 2·5–3·5 cm. raro adusque 6·5 cm. lat., in sicco plus minus brunneo-olivaceo-viridia; costæ supra planæ, subtus eminentes; rete videre vix potuimus; petioli 0·5–1·5 cm. long., crassiusculi. Stipulæ 4–5 mm. long. Cymæ evolutæ circa 2·5 cm. long.; pedunculus communis tandem 2·5 cm. long. Flores albi. Ovarium 2 mm. long.; calycis limbus 1·2 mm. long.; lobi dum adsint deltoidei, obtusi, summum 0·8 mm. long. Corollæ tubus 4·5 mm. long., basi 2 mm. faucibus 3 mm. lat.; lobi 2·25 mm. long. Filamenta juxta medium tubum inserta, ægre 2 mm. long.; antheræ 0·8 mm. long. Discus 1·5 mm. alt., crassus. Stylus 2·5 mm. long., hujus rami 1 mm.

Bacca sicca 5 × 5·2 mm., calycis reliquiis fere evanidis coronata, punicea. Seminum albumen ruminatum.

Nearest *G. oblanceolatum*, K. Schum., which, among other features, has narrower leaves, entire stipules, and smaller yellow flowers. One of the specimens, numbered as above, has larger and broader leaves, puberulous on the nerves of the underside, but there seems no reason for considering it specifically different from the others.

GEOPHILA UNIFLORA, *Hiern, in Fl. Trop. Afr.* iii. 221.

Forming a carpet in many parts of Chirinda Forest, 3700–4000 ft.; in. fl. March; n. 350.

Distrib. Tropical Africa.

OTIOPHORA INYANGANA, *N. E. Br. in Kew Bull.* 1906, 107.

Near and on Mt. Pene, in open short-grass veldt 7000 ft.; in fl. Sept., Oct.; nos. 2007, 6146.

Distrib. Rhodesia.

GALOPINA CIRCÆOIDES, *Thunb. Nov. Gen.* i. 3.

Near Chirinda; in fl. & fr. April; n. 317.

Distrib. South Africa.

Apparently not hitherto recorded as tropical; but there is at Kew a specimen from Mafusi, Mozambique, collected recently by Archdeacon Johnson.

ANTHOSPERMUM LANCEOLATUM, *Thunb. Prod. Fl. Cap.* 32.

Mount Maruma, 3500 ft.; in fl. & fr. Sept.; n. 2148.

Distrib. Uganda to South Africa.

ANTHOSPERMUM AMMANIOIDES, *S. Moore*, sp. nov.

Fruticulus caule erecto satis valido superne ramuloso ut ramuli hispidulo-pubescente demum glabro, foliis ternatis sessilibus lineari-lanceolatis acuminatis supra scabriusculis subtus hispidulo-pubescentibus verticillis junioribus approximatis senioribus satis distantibus, stipulis integris a basi lata subulato-filiformibus sparsim hispidulis, floribus masculis in axillis fasciculatis breviter pedicellatis tetrameris, calycis limbo subobsoleto, corollæ lobis tubum excedentibus ovato-oblongis obtusiusculis revolutis, floribus femineis ignotis.

Hab. Melsetter, 6000 ft.; in fl. April; n. 2156.

Folia profecto evoluta 2–3 cm. long., juniora ± 1 cm., 2–4 mm. lat., firme membranacea, supra fusca, subtus grisea. Stipulæ 2–3 mm. long. Pedicelli addito ovarii rudimento vix ab iis secernendo 0·75 mm. long. Corollæ tubus 1 mm., lobi 2 mm. long. Stamina exserta; filamenta tenuissima, fere 3 mm., antheræ 1·75 mm. long.

Known by its indumentum, entire stipules, ternate leaves, and fascicled flowers. The affinity is with *A. hispidulum*, E. Mey.

ANTHOSPERMUM VALLICOLUM, *S. Moore*, sp. nov.

Fruticulus ramosus ramulis patenti-ascendentibus crebro foliosis subteretibus minutissime puberulis, foliis verticillatis linearibus apice mucronulatis ima basi inter se necnon cum stipulis vaginatim connatis margine revolutis subtus microscopice puberulis, stipulis parvulis integris subulatis, floribus masculis ignotis, floribus femineis in axillis ramulorum perbrevium axillarium parvifoliatorum fasciculatis, calycis lobis 4 deltoideis acutis vel acuminatis, corolla ignota, coccis plano-convexis glabris.

Hab. Chimanimani Mts. at 7000 ft., forming thickets in the glens; in fl. Sept.; n. 2155.

Folia adulta usque ad 4 cm. long., 1–3 mm. lat. (ramulorum fertilium 1 cm. long.), membranacea, in sicco grisea. Stipulæ ± 1 mm. long. Fructuum calycis lobi persistentes ± 1 mm. long. Cocci exsiccati ægre 2 mm. long.

Recognized by the long and narrow leaves, with the very short fertile branches crowded with small leaves in their axils. The affinity appears to be with *A. pachyrrhizum*, Hiern.

RICHARDSONIA BRASILIENSIS, *Hayne, Arzn. Gew.* viii. t. 21.
Near Chirinda, 3700 ft.; in fl. & fr. Nov.; n. 2134.
Distrib. Zambesia to Natal. Also in Tropical America.

BORRERIA NATALENSIS, *K. Schum. MS.*
Spermacoce natalensis, Hochst. in Flora, xxvii. (1844) 555.
Near Chirinda; in fl. May; nos. 376, 518.
Distrib. Natal to Mozambique.

RUBIA CORDIFOLIA, *Linn. Syst.* 229.
Near Chirinda, 3800 ft.; in fl. April; n. 216.
Distrib. Tropical and South Africa, East Asia and Malaya.

GALIUM STENOPHYLLUM, *Baker, in Kew Bull.* 1895, 69.
Near Chipete Forest Patch, 3800 ft.; in fl. & fr. July; n. 2141.
Distrib. Uganda to Nyasaland.

DIPSACEÆ.

SCABIOSA COLUMBARIA, *Linn. Sp. Pl.* 99.
Near Chirinda and Mt. Pene; in fl. April, Sept.; nos. 278, 1143.
Distrib. Throughout Africa; also in Europe and the Orient.

COMPOSITÆ.

The following weeds are in the collection:—*Ethulia conyzoides,* Linn. fil., *Vernonia cinerea*, Less., *Mikania scandens,* Willd., *Ageratum conyzoides,* Linn., *Adenostemma viscosum*, Forst., *Conyza ægyptiaca*, Ait., *Erigeron*

canadense, Linn., *Dichrocephala latifolia*, DC., *Pluchea dioscoridis*, DC., *Blumea lacera*, DC., *Eclipta alba*, Linn., *Siegesbeckia orientalis*, Linn., *Bidens pilosa*, Linn., *Spilanthes Acmella*, Linn., *Gynura cernua*, Benth., and *crepidioides*, Benth., *Emilia sagittata*, DC., and *Sonchus oleraceus*, Linn.

ERLANGEA LONGIPES, *S. Moore, in Journ. Linn. Soc., Bot.* xxxv. (1902) 313.

Near Chirinda; Melsetter and Upper Buzi; in fl. April, Sept.; nos. 391, 1809, 1809 *a*.

Distrib. Central Lake Region to Rhodesia.

VERNONIA BAINESII, *Oliver & Hiern, in Oliver, Fl. Trop. Afr.* iii. 272.

Source of Chipetzana, 4000 ft.; hills between Lusitu and Nyahodi rivers, 5000 ft.; in fl. April; nos. 1903, 1903 *a*.

Distrib. Northern Transvaal.

V. POSKEANA, *Vatke & Hildebr. in Oest. Bot. Zeitschr.* xxv. (1875) 324. Var. CHLOROLEPIS, *O. Hoffm. in Bol. Soc. Brot.* x. 171. Madanda forests at about 400 ft.; Chipetzana River at 3000 ft.; in fl. April, Dec.; nos. 1828, 1828 *a*.

Distrib. (of var.). Tropical East Africa to Angola.

V. HOLSTII, *O. Hoffm. in Engl. Bot. Jahrb.* xx. (1894) 220.

Outskirts of Chirinda, 3700–4000 ft.; in fl. June; n. 523 *a*.

Distrib. Tropical East Africa.

VERNONIA (§ Lepidella) ACUMINATISSIMA, *S. Moore*, sp. nov.

Herbacea caule erecto rariramoso ut rami fulvo- vel griseo-hirsuto-pubescente, foliis sessilibus oblanceolatis vel oblanceolato-oblongis obtusis vel pungenti-mucronatis basin versus leviter angustatis integris denticulatisve membranaceis utrinque sed præsertim pagina inferiore appresse hirsuto-pubescentibus, capitulis submediocribus circa 50-flosculosis paniculam sub-corymbosam folia magnopere excedentem laxe paucicephalam bracteatam hirsuto-pubescentem referentibus, bracteis lineari-lanceolatis superioribus linearibus apice pungenti-acuminatis hirsuto-pubescentibus, involucri late campanulati hirsuto-pubescentis 4-serialis phyllis exterioribus angustissime linearibus quam interiora lineari-lanceolata plane brevioribus sæpe recurvis phyllis omnibus sursum spinuloso-acuminatis, flosculis breviter exsertis purpureis, achæniis cylindricis 5-costatis inter costas pilis strigillosis appressis onustis, pappi squamis linearibus acutiusculis quam setæ uniseriales scabridæ sordide albæ vel dilute stramineæ multo brevioribus.

Hab. Upper Buzi River, at 3500 ft., open woods at Beira; in fl. May, Dec.; nos. 1906, 1907.

Folia 3–8 cm. long., 8–20 mm. lat., in sicco pagina superiore olivacea, nferiore grisea diluteve fulva. Inflorescentia 10 cm. long., vel ultra.

Bracteæ inferiores circa 1 cm. long., superiores usque ad 5–7 mm. imminutæ, hæ acumine nigro gaudientes. Pedunculi proprii sæpissime 1–3 cm. long. Involucra 1 × 1·5 cm.; phylla exteriora 5 mm. long., intermedia circa 7 mm., interiora 9 mm. long., hæc 1·5–2 mm. lat., trinervia. Corollæ tubus sursum leviter ampliatus extus sparsim papillosus, 7–8 mm. long.; lobi anguste lineari-oblongi, acuti, 3 mm. long. Styli rami 3·5 mm. long. Achænia 2 mm., pappi squamæ 0·4 mm., setæ 6–6·5 mm. long.

Besides the specimens mentioned above, *V. acuminatissima* is represented at the British Museum by one collected in East Tropical Africa (probably at Mombasa or in that neighbourhood) by Rev. W. E. Taylor, as also by others at Kew sent from Inhambane by Mr. L. Scott. The affinity is with *V. demulans*, Vatke, from which it can be distinguished on sight by the larger heads with narrower and more lengthily acuminate involucral leaves, the larger florets, and the long pappus.

VERNONIA CISTIFOLIA, *O. Hoffm. in Engl. Pflanzenw. Ost-Afr.* C. 404. Var. ROSEA, *O. Hoffm. l. c.* Near Chirinda, 3800 ft.; in fl. May; n. 496.

Distrib. German East Africa, Nyassaland.

VERNONIA (§ Lepidella) GRACILIPES, *S. Moore*, sp. nov.

Herbacea caule ascendente pluristriato cito glabrescente novellis fulvo-pubescentibus, foliis brevipetiolatis oblongo- vel lineari-lanceolatis sursum gradatim attenuatis apice breviter acuminatis basi acutis margine late dentato-serratis papyraceis cito glabris vel fere glabris glandulis immersis crebro instructis in sicco læte viridibus, capitulis parvis circa 21-flosculosis in paniculas corymbosas terminales laxas pleiocephalas folia circiter æquantes appresse pubescentes dispositis, involucri campanulati 4-serialis pubescentis phyllis intus gradatim longioribus exterioribus (seriebus 1–3) lineari-lanceolatis breviter acuminatis intimis oblongis acutis vel acutiusculis, flosculis exsertis purpureis, corollæ extus glandulis minimis lucentibus sparsim inspersæ tubo superne sensim dilatato, achæniis cylindricis obscure costatis appresse setulosis, pappi squamis angustissime linearibus quam setæ albidæ scabridæ pluries brevioribus.

Hab. Chimanimani Mountains at 7000 ft.; Mt. Pene at 6500–7000 ft.; in fl. Sept., Oct.; nos. 1830, 1830 *a*, 6126, 6127.

Folia vulgo 7–9 cm. long., 2·3–3·7 cm. lat. (nonnumquam 4·5–6 × ·5–1 cm.), pagina inferiore pallidiora; petioli sæpissime 5–8 mm. long. Paniculæ 8–12 cm. long. (raro solummodo 3 cm.) et 6–12 cm. lat., harum ramuli divaricati; pedunculi proprii attenuati, sæpius 6–20 mm. long. Involucra 5 × 6 mm.; phylla extima 1 mm., intermedia 1·5–2 mm., intima 4·2 mm. long. Corollæ tubus 4·5 mm. long.; lobi lineares, acuti, 3·5 mm. long. Styli rami 2 mm. long. Achænia 1·75 mm. long.; pappi squamæ vix 1 mm., setæ 5·5 mm. long.

Var. MINOR. Folia ovato-oblonga, utrinque obtusa, supra scabriuscula, subtus sparsim pubescentia, modo 2–4 cm. long., 1·2–2·5 cm. lat. Capitula circa 15-flosculosa.

Hab. Chimanimani Mountains, 7000 ft. ; in fl. Sept. ; n. 1909.

This is a near ally of *V. Wollastonii*, S. Moore, differing, among other points, in the deeper toothing of the leaves, and the short involucres with relatively broader and blunter leaves.

VERNONIA KRAUSSII, *Sch. Bip. in Walp. Rep.* ii. 947.

Mt. Pene, 6000–7000 ft., Umvumvumvu River at 4000 ft.; in fl. Sept., Oct. ; nos. 1827, 6002, 6141, 6142.

Distrib. Rhodesia, Nayasaland, South Africa.

V. NATALENSIS, *Sch. Bip. in Walp. Rep.* ii. 947.

In grass near Chirinda, 3800 ft. ; Mt. Pene, 7000 ft. ; in fl. Oct. ; nos. 275, 6145.

Distrib. Ukamba, Mozambique and Nyasaland to Angola ; also in South Africa.

Chindao name, "Tshiwonika" ; "bush-tea" of settlers. A common herb sometimes infused in water by the white settler and used to induce perspiration in fever ; it forms a good substitute for tea and coffee.

V. HIRSUTA, *Sch. Bip. in Walp. Rep.* ii. 947.

Northern Melsetter at 5000–6000 ft.; in fl. Oct. ; nos. 6116, 6138.

Distrib. South Africa.

V. MONOCEPHALA, *Harv. Fl. Cap.* iii. 53.

Melsetter at 6000 ft. ; Chimanimani Mts. at 7000 ft. ; in. fl. Sept., Oct.; nos. 1829, 6144.

Distrib. South Africa.

V. GERBERÆFORMIS, *Oliver & Hiern, in Fl. Trop. Afr.* iii. 285.

Melsetter at 6000 ft. ; Mt. Pene, 6500–7000 ft. ; in fl. Sept., Oct. ; nos. 1900, 6112.

Distrib. Central Lake Region to Rhodesia.

V. GLABRA, *Vatke, in Oesterr. Bot. Zeitschr.* xxvii. (1877) 194.

Near Chirinda at 3500 ft. ; Chipetzana River at 3000 ft. ; open woods at Beira ; in fl. April, Aug., Dec. ; nos. 1814, 1831, 1831 *a*.

Distrib. British East Africa to Nyasaland and Rhodesia.

V. WOODII, *O. Hoffm. in Engl. Bot. Jahrb.* xxxviii. (1906) 198.

Melsetter, 6000 ft. ; near Chipinga, Upper Buzi, 3000 ft. ; in. fl. April, May ; nos. 1824, 1824 *a*.

Distrib. Natal.

A tall herb very common in the grassier glens about Chirinda and in old abandoned fields and grass-jungles generally. Flowers white with purple centre.

VERNONIA (§ Stengelia) SWYNNERTONII, *S. Moore*, sp. nov.

Herbacea, erecta, caule tereti longitrorsum sulcato sursum sparsim ramoso modice folioso ut rami griseo-tomentello dein pubescente, foliis sessilibus comparate elongatis linearibus obtusis vel obtuse acutis integris vel rarissime minute denticulatis firme membranaceis supra pubescentibus subtus griseo-tomentellis, capitulis mediocribus multiflosculosis in corymbum terminalem laxum pauci-(vulgo 3-)cephalum bracteatum tomentellum digestis, involucri late campanulati araneoso-pubescentis circa 8-serialis phyllis exterioribus abbreviatis lanceolato- vel ovato-oblongis apice nigro-mucronatis coriaceis quam interiora gradatim accrescentia oblonga appendice oblonga apice nigro-mucronata in sicco brunnea onusta multo brevioribus, corollæ tubo superne gradatim amplificato glabro, achæniis subcylindricis compressiusculis 12-costatis appresse albo-hirsutulis, pappi setis breviter barbellatis cinereis quam exteriora squamiformia abbreviata barbellata pluries longioribus.

Hab. Lower Buzi River, up to 400 ft.; in fl. Dec.; n. 1908.

Folia solemniter 6–10 cm. long., 4–7 mm. lat. Corymbi 10 cm. long., vel etiam ultra. Pedunculi proprii 6–10 cm. long. Bracteæ inferiores lineares, circa 1 cm. long., superiores gradatim imminutæ. Involucra 1·5 cm. long., 2 cm. (tandem 2·5 cm.) diam. Phylla exteriora 2·5–4 mm. long., intermedia 5–8 mm., intima 12–13 mm. long. Corollæ tubus 6 mm. long., inferne 0·4 mm., superne 0·8–1 mm. diam.; lobi lineares, 3 mm. long. Achænia 2·2 mm. long.; pappi squamæ vix 1 mm., setæ 4·5–5 mm. long.

Near *V. Grantii,* Oliver, but entirely different in leaf, the lax inflorescences, the narrow involucral leaves, the pappus, &c.

V. LIVINGSTONIANA, *Oliver & Hiern, in Fl. Trop. Afr.* iii. 295.

Kurumadzi River, Jihu, 2000 ft.; in fl. Nov.; n. 126.

Distrib. Zambesia, Nyasaland.

V. PODOCOMA, *Sch. Bip. ex Schweinf. & Aschers. Enum.* 287.

Chirinda Forest; Mt. Maruma, 3800 ft.; in fl. Sept.; nos. 113, 113 *a*.

Distrib. Abyssinia to Angola and Rhodesia.

Chindao name, "Idambasese." Exceedingly plentiful along the outskirts of Chirinda, where in some places it almost forms a hedge. Attractive to Lepidoptera. Bark of roots very bitter, chewed for pains in the chest; a good cure, it is said.

MICROGLOSSA VOLUBILIS, *DC. Prod.* v. 320.

Mt. Umtereni, 4000 ft.; in fl. Sept.; n. 1801.

Distrib. Tropical Africa, Madagascar, East Indies.

NIDORELLA MICROCEPHALA, *Steetz, in Peters, Mossamb. Bot.* 406.

Near Chirinda, 3700–4000 ft.; Lower Umswirizwi River, 1000 ft.; Madanda forests at about 400 ft.; Chibabava, Lower Buzi; in fl. May, June, Nov., Dec.; nos. 287, 287 *a*, 314, 1860, 1860 *a*.

Distrib. Tropical East Africa.

CONYZA PERSICÆFOLIA, *Oliver & Hiern, in Fl. Trop. Afr.* iii. 312.

Outskirts of Chirinda, 3700–4000 ft.; in fl. June; nos. 2065, 2065 *a*.

Distrib. Tropical Africa.

The leaves, when crushed, smell somewhat unpleasantly of *Conium maculatum.*

C. VARIEGATA, *Sch. Bip. ex A. Rich. Tent. Fl. Abyss.* i. 339.

Melsetter at 6000 ft.; in fl. Oct.; n. 6128.

Distrib. Abyssinia to Rhodesia.

LAGGERA ALATA, *Sch. Bip. ex Oliver, in Trans. Linn. Soc.* xxix. (1873) 94.

Near Chirinda, 3800 ft.; in fl. May; n. 498.

Distrib. Tropical Africa, Mascarene Islands, East Indies.

L. BREVIPES, *Oliver & Hiern, in Fl. Trop Afr.* iii. 327.

Near Chirinda, 3500 ft.; in fl. July; n. 2066.

Distrib. Angola to Zambesia.

EPALTES GARIEPINA, *Steetz, in Peters, Mossamb. Bot.* 451.

Chipete Forest Patch, 3800 ft.; Northern Melsetter, 200–600 ft.; in fl. April; nos. 198, 1819.

Distrib. Tropical and South Africa.

BRACHYLÆNA RHODESIANA, *S. Moore, in Journ. Linn. Soc., Bot.* xxxvii. (1906) 448.

Madanda forests at about 400 ft.; Kurumadzi River, 2000 ft.; Inyamadzi Valley, 3000 ft.; Chipetzana River, 3000 ft.; Delagoa Bay; in fl. Aug.–Oct.; nos. 1854, 1855, 1856, 1857, 6515.

Distrib. Confined to Rhodesia so far as known.

HELICHRYSUM ARGYROSPHÆRUM, *DC. Prod.* vi. 174.

Near Chirinda, 3700 ft.; in fl. Aug.; n. 1806.

Distrib. South tropical Africa and South Africa.

H. ADENOCARPUM, *DC. Prod.* vi. 180.

Near Chirinda; Chipetzana River; Nyahodi River; in. fl. April, May; nos. 1842, 1843, 1843 *a*, 1843 *b*.

Distrib. East tropical Africa from German East Africa southward; also in South Africa.

HELICHRYSUM BUCHANANI, *Engl. in Abhandl. Preuss. Akad. Wiss.* 1891 (1892) 429.

Melsetter at 6000 ft. ; in. fl. Sept. ; n. 1905.

Distrib. Nyasaland.

H. SETOSUM, *Harv. Fl. Cap.* iii. 231.

Near Chirinda ; Melsetter at 6000 ft. ; in fl. April ; nos. 279, 279 *a*, 281.

Distrib. East Africa from Uganda southwards ; also in South Africa.

H. NITENS, *Oliver & Hiern, in Fl. Trop. Afr.* iii. 350.

Near Chirinda, Chimanimani Mountains ; Mt. Pene, 6500–7000 ft. ; Melsetter, 6000 ft. ; in fl. Aug.–Oct. ; nos. 280, 1836, 1839, 1840, 6111.

Distrib. Usambara to Rhodesia.

HELICHRYSUM (Chrysolepidea, Xerochlæna) SWYNNERTONII, *S. Moore*, sp. nov.

Herbaceum, perenne, caulibus e rhizomate lignoso valido ascendentibus griseo-tomentosis inferne dense foliosis superne foliis imminutis sparsim instructis, foliis sessilibus oblongo-lanceolatis rarius ovato-oblongis obtusis haud decurrentibus utrinque tela griseo-tomentosa arcte intricata indutis membranaceis, capitulis solitariis majusculis campanulatis multifloseulis homogamis, involucri circa 9-serialis glabri phyllis ovatis vel ovato-oblongis obtusis firme scariosis dilute albido-fulvis tandem radiantibus, corollis inclusis superne leviter ampliatis limbi lobis parvis triangularibus, antherarum caudis subsimplicibus, achæniis cylindricis sparsim papillosis, pappi setis pluribus ima basi connatis glabris albis.

Hab. Melsetter at 6000 ft. ; in fl. Oct. ; n. 6110.

Planta semispithamea vel ultra. Folia vulgo 3·5–5 cm. long., 1–1·5 cm. lat., trinervia, summa ± 1 cm. long. Capitula circa 17 × 24 mm. Involucri phylla extima 5–6 mm., intermedia 11 mm., intima 14 mm. long. Corollæ 11 mm. long., inferne 0·25 mm., ore ægre 1 mm. long. Achænia 1·25 mm., pappus 12 mm. long.

To be inserted in the genus close to *H. squamosum*, Thunb., from which it can be distinguished on sight by the stouter habit, the broad leaves and pale involucres.

HELICHRYSUM (Chrysolepidea § Stæchadina) ACERVATUM, *S. Moore*, sp. nov.

Herbacea, caule simplici vel perpauciramoso usque ad apicem crebro folioso ut folia tela araneosa dense obsito, foliis sessilibus oblongo-obovatis apice latis ipso subito obtuse acutis basi leviter angustatis vix amplexicaulibus breviter decurrentibus, capitulis homogamis 3-flosculosis in glomerulos paucos subsessiles brevipedunculatosve ad apicem caulis confertos et bracteis involucri phylla mentientibus intermixtos dispositis, involucri anguste cylindrici 3-serialis phyllis oblongis apice truncatis ibidemque denticulatis haud radiantibus extimis ut pedunculi et bracteæ inferne araneosis intimis quam reliqua paullulum brevioribus omnibus citrinis extimis sæpe sursum dilute

roseis, corollis omnimodo glabris, antherarum caudis simplicibus, achæniis (hucusque valde crudis) cylindricis glabris, pappi setis 4 corollas excedentibus fere a basi paullo dilatatis leviter scabriusculis albis.

Hab. Chimanimani Mountains at 7000 ft.; in fl. Sept.; n. 1845.

Planta saltem ultraspithamea. Folia radicalia desunt; caulina 1·5–3 cm. long., 7–15 mm. lat., juniora gradatim imminuta summa vero in bracteas haud transeuntia. Glomerulorum fasciculi 1·5–2·5–3 cm.; horum pedunculi 2–5 mm. long. Bracteæ ± 6 mm. long. Involucri phylla 5 mm. long. (intima 4·7 mm.). Corollæ 2 mm. long. Achænia 0·4 mm., pappi setæ 3 mm. long.

To be placed near *H. subglomeratum*, Less., from which it differs in so many points as to render details unnecessary. It is still nearer the recently published *H. alticolum*, Bolus, which, among other features, has the stem leafless in its upper part and bearing larger leaves below, 4–5 floscules to the capitulum, acute or subobtuse involucral leaves, papillose corolla-lobes, and barbellate pappus-hairs.

HELICHRYSUM LATIFOLIUM, *Less. Syn.* 297.

Near Chirinda; in fl. May; n. 510.

Distrib. Nyasaland, Rhodesia and South Africa.

H. LEIOPODIUM, *DC. Prod.* vi. 200.

Near Chirinda, 3800 ft.; Lusitu River at about 4000 ft.; Mt. Pene, 6500–7000 ft.; in fl. April, May, Sept.; nos. 307, 502, 1837, 1852.

Distrib. Tropical and South Africa.

H. APPENDICULATUM, *Less. Syn.* 308.

Near Chirinda, 3700 ft.; Upper Buzi, 3500 ft.; in fl. May, Nov.; nos. 1851, 1851 *a*.

Distrib. A South African plant.

H. STENOPTERUM, *DC. Prod.* vi. 201. Var. CITRINUM, *S. Moore, in Journ. Bot.* xlvi. (1908) 41. Melsetter and near Chirinda; in fl. June, Sept.; nos. 1841, 1841 *a*.

Distrib. (of type) South Africa; (of var.) Rhodesia.

H. KRAUSSII, *Sch. Bip. in Flora*, xxvii. (1844) 679.

Melsetter; near Chipinge, Upper Buzi, at 3600 ft.; Beira beach; in fl. May, Sept., Dec.; nos. 1835, 1835 *a*, 1850.

Distrib. Rhodesia, South Africa.

HELICHRYSUM (Lepicline § Aptera) GAZENSE, *S. Moore*, sp. nov.

Suffrutex ascendens, pauciramosus, usque ad apicem crebro foliosus, ramis tela araneosa persistente arcte circumdatis, foliis sat longipetiolatis oblongo-

spathulatis vel spathulato-obovatis obtusis basi nec auriculatis nec decurrentibus supra araneosis subtus dense cinereo-tomentosis, capitulis parvis 15-flosculosis homogamis in corymbos terminales subconfertos bracteatos polycephalos dense tomentosos digestis, involucri campanulati circa 4-serialis phyllis erectis ovato-oblongis vel ovato-lanceolatis obtusis obtusissimisve interioribus gradatim longioribus exterioribus ima basi laxe araneosis omnibus stramineis nitidisque, corollis inclusis superne manifeste amplificatis, antherarum caudis simplicibus, achæniis maturis angustissime fusiformibus glabris, pappi setis paucis levibus albis.

Hab. Melsetter at 6000 ft. ; in fl. Sept. ; n. 1853.

Planta verisimiliter circa spithamea. Foliorum limbus 10–17 mm. long., 5–11 mm. lat. ; hujus costæ sub tela omnino obsconditæ ; petioli usque ad 10 mm. long., plerumque vero breviores, satis lati, dense araneosi. Corymbi 2·5–3 × 4–4·5 cm. ; horum bracteæ ultimæ 3–5 mm. long., inferiores in folia transeuntes. Pedunculi proprii vulgo 2–3 mm. long. Involucra 5 × 4 mm. : phylla extima 2·5 mm., interiora circa 3·5 mm., intima 4 mm. long. Receptaculi paleæ ovatæ vel oblongæ, obtusæ, stramineæ, 0·5–0·75 mm. long. Corollæ 3 mm. long., inferne 0·2 mm., superne 0·5 mm. lat. ; lobi 5, parvuli, triangulares, acuti. Achænia 1·25 mm. long. ; pappi setæ 3–4 mm.

On a first view this looks somewhat like *H. crispum*, Less., but its stalked leaves bring it still nearer to *H. petiolatum*, DC. From the latter it differs, *inter alia*, in the apparently lowlier habit, narrower leaves, smaller heads with straw-coloured (not milk-white) involucres, and the fewer florets, with their corollas markedly enlarged in the upper half.

HELICHRYSUM (Lepicline § Aptera) BRUNIOIDES, *S. Moore*, sp. nov.

Suffruticosum, ascendens, crebro ramosum, ramis attenuatis subteretibus usque ad apicem foliosis araneoso-tomentosis, foliis parvulis anguste lineari-lanceolatis leviter amplexicaulibus apice mucronulatis haud decurrentibus in sicco planis revolutisve membranaceis utrinsecus sed precipue pagina inferiore albo-araneosis, capitulis parvulis heterogamis 9–11-flosculosis araneoso-puberulis cymam ramos terminantem abbreviatam oligocephalam subconfertam bracteatam araneosam efformantibus, involucri anguste ovoidei phyllis 3-serialibus oblongis extimis quam cetera paullulum brevioribus dilute brunneis omnibus appendice parvula oblonga obtusa ut præter apicem sordide albam concolore præditis, flosculis inclusis cujusque capituli 2 femineis, corollæ florum hermaphroditorum tubo cylindrico faucibus ipsis subito amplificatis limbo sat amplo lobis 5 triangulari-deltoideis acutis, antherarum caudis simplicibus, achæniis subcylindricis compressiusculis vix omnino glabris, pappi setis paucis scabriusculis albis.

Hab. Chimanimani Mountains at 7000 ft. ; in fl. Sept. ; n. 1847.

Folia ± 5 mm. long., juxta basin circa 1·5–3 mm. lat., medium versus 1–2 mm., uninervia ; costa media subtus prominens ; folia summa anguste

linearia, longe acuminata, in bracteas sensim transeuntia. Cymæ 5 mm. long., 8–10 mm. diam.; harum bracteæ summæ 1·5 mm. long., vel etiam minus. Pedunculi proprii involucris suis sæpissime breviores. Involucra 2×1 mm. vel paullulum ultra; phylla extima 1·5 mm., interiora 1·8 mm. long. Corollæ tubi pars attenuata 1 mm. long., fauces 0·2 mm., illa 0·15 mm. hæ 0·5 mm. lat.

A plant with much the look of *H. Dregeanum*, Sond. & Harv., which has longer and narrower coriaceous leaves, larger heads, each with 20–25 florets, broader very obtuse involucral leaves, &c.

HELICHRYSUM AURICULATUM, *Less. Syn.* 311.

Near Chirinda, 3700 ft.; in fl. June; n. 1838.

Distrib. South tropical Africa and South Africa.

HUMEA AFRICANA, *S. Moore*, sp. nov. (Pl. **5**. figs. 1–3.)

Suffrutex ramosus ramis subteretibus superne crebro foliosis ut folia tomento cinereo-albo obtectis, foliis sessilibus oblongo-ovatis obtusis basin versus aliquanto angustatis levissime decurrentibus utrobique cinereo-tomentosis trinervibus, capitulis parvulis florem unicum hermaphroditum includentibus in cymas breviter pedunculatas polycephalas confertas bracteatas tomentosas ordinatis, involucri angustissime cylindrici 5-serialis phyllis erectis exterioribus satis abbreviatis rotundatis obtusissimis vel emarginatis intermediis ovatis interioribus ovato-oblongis obtusis omnibus dilute citrinis, corollæ ex involucro breviter eminentis tubo stricte cylindrico lobis 5 triangularibus acutis, antherarum caudis simplicibus, achæniis adhuc crudis ovoideo-oblongis compressiusculis glabris ad normam generis omnino calvis.

Hab. Chimanimani Mountains at 7000 ft.; in fl. Sept.; n. 1849.

Folia 1–1·5 cm. long., 5–8 mm. lat. Inflorescentiæ 2×3·5–4·5 cm.; harum bracteæ foliis similes nisi (summæ insigniter) minores. Pedunculi proprii brevissimi vel 0. Involucra 2·75 mm. long., 0·5–0·75 mm. lat.; phylla extima 1 mm. long., intermedia 1·5 mm., intima adusque 2·5 mm. Corollæ flavæ, 2·5 mm. long. Styli rami aliquanto applanati, truncati, penicillati, 0·6 mm. long. Achænia 0·4 mm. long.

Humea is a genus hitherto supposed to be restricted to Australia, and if it is to be retained as distinct from *Helichrysum*, I fail to see how the plant under notice can be excluded from *Humea*. A second African species is *H. infausta* (*Helichrysum infaustum*, Wood & Evans); a third *H. epapposa* (*Helichrysum epapposum*, Bolus), and there are one or two more. They make up the § *Infausta* of Moeser (Engl. Bot. Jahrb. xliii. (1909) 458).

ATHRIXIA OBLONGA, *S. Moore*, sp. nov.

Herbacea caule erecto subtereti araneoso dense folioso, foliis sessilibus (raro subsessilibus) oblongis vel anguste oblongo-lanceolatis apice pungentibus basi obtusis margine distanter serrato-dentatis undulatisve dentibus pungentibus trinervibus coriaceis supra araneosis subtus griseo-araneoso-tomentosis,

capitulis pro rata mediocribus radiatis in corymbum foliatum pluricephalum sat elongatum araneosum dispositis; pedunculis propriis quam capitula sæpius brevioribus bracteis parvis interdum onustis, involucri hemisphærici araneosi phyllis pluriseriatis lineari-lanceolatis breviter spinoso-acuminatis apice sphacelatis necnon sæpe recurvis intimis manifeste longioribus, ligulis pluribus ex involucro bene eminentibus, antherarum caudis maxime attenuatis, styli ramis complanatis apice truncatis, achæniis cylindricis 5-costatis basi villosulis alibi microscopice puberulis, pappi setis sordide albis scabridis.

Hab. Near Chirinda at 3800 ft.; in grass; in fl. Oct.; n. 276.

Folia ± 3·0 cm. long., 0·6–0·8 (raro 1·0) cm. lat., pagina superiore pallidissime nitescentia et eleganter reticulata, inf. (costa centrali perspicua exempta) fere enervosa. Corymbus summum 10 cm. long., et 6 cm. diam.; hujus bracteæ lineares vel lineari-lanceolatæ, ± 0·8 cm. long. Capitula 1·0 cm. diam. Involucra 0·6 cm. long., et latitudine propemodum æqualia; phylla extima vix 0·3 cm., intermedia 0·4 cm., intima 0·5 cm. long. Ligulæ oblongæ, apice 3-denticulatæ, 0·5 cm. long., puniceæ. Disci corollæ sursum leviter ac gradatim dilatata, 0·5 cm. long. Achænia valde cruda 0·1 cm., pappi setæ 0·45 cm. long.

A very distinct species, with *A. phylicoides*, DC., for its nearest ally. From this it can be readily distinguished by the longer oblong, often toothed leaves and the hemispherical heads. According to Mr. Swynnerton, it is a common herb in the grass.

ATHRIXIA FOLIOSA, *S. Moore*, sp. nov.

Herbacea, caule ramulisque sat attenuatis ascendentibus crebro foliosis hispide pubescentibus, foliis lineari- vel oblongo-lanceolatis acutis apice mucronatis basi rotundatis necnon levissime amplexicaulibus margine leviter revolutis membranaceis supra scaberrimis subtus araneoso-tomentellis, capitulis mediocribus radiatis in corymbos ramulos coronantes breves oligocephalos bracteatos hispidulos digestis, involucri campanulati laxe araneosi 5-serialis phyllis anguste lineari-lanceolatis breviter acuminatis exterioribus saltem in sicco sæpissime sursum recurvis patentibusve, ligulis circa 12 longe exsertis oblongis obtusis dilute lavandulaceis, styli ramis applanatis truncatis, achæniis cylindricis obscure costatis basi tantum villosulis, pappi setis apicem versus scabriusculis albis setulis maxime abbreviatis intermixtis.

Hab. Melsetter, 6000 ft.; in fl. July; n. 1820.

Folia vulgo 2–4 cm. long., 4–10 mm. lat., supra sublæte-subtus griseo-viridia; costa media subtus eminens tegmine araneoso fere orba. Corymbi 2–4 × 3–4 cm. Bracteæ lineares, ultimæ 1–3 mm. long. Pedunculi proprii 3–10 mm. long. Involucra 7·5 × 8 mm.; phylla exteriora 2–4 mm., intermedia 5–6 mm., intima 7 mm. long., omnia sursum aliquanto sphacelata. Ligulæ 7 × 2·2 mm. Achænia 1·2 mm., pappi setæ 5 mm., setulæ 0·2 mm. long.

Distinguished *inter alia* by the broad leaves and the pappus.

ATHRIXIA ROSMARINIFOLIA, *Oliver & Hiern, in Fl. Trop. Afr.* iii. 355.

Northern Melsetter at 5000–6000 ft.; Umvumvumvu at 4000 ft.; in fl. Oct.; nos. 6135, 6137, 6137 *a*, 6219.

Distrib. East Tropical Africa.

INULA ACERVATA, *S. Moore, in Journ. Linn. Soc., Bot.* xxxv. (1902) 340.

Near Chirinda, 3800 ft.; in fl. May; n. 460.

Distrib. Nyasaland.

GEIGERIA RHODESIANA, *S. Moore, in Journ. Bot.* xlvi. (1908) 41.

In short grass near Chirinda, 3800 ft.; Nyahodi River at about 5000 ft.; Chipetzana River at 3000 ft.; in fl. April, May; nos. 490, 1817, 1823.

Distrib. Rhodesia.

SPHACOPHYLLUM SPARSUM, *S. Moore*, sp. nov.

Herba erecta, ramis ascendentibus paucifoliosis piloso-hirtulis, foliis parvulis petiolatis ovato-oblongis obtusis basi truncatis subrotundatisve margine serrato-dentatis dentibus induratis utrinque piloso-hirtulis, capitulis mediocribus ∞-flosculosis longipedunculatis corymbum paucicephalum bracteatum referentibus, receptaculi paleis cymbiformibus acuminatis, involucri 4–5-serialis phyllis exterioribus late oblongo-ovatis ovatisve acutiusculis vel obtusiusculis interioribus longioribus oblongo-lanceolatis acutis omnibus margine ciliatis trinervibus, ligulis ultra 20 ex involucro bene eminentibus, antherarum caudis attenuatis, achæniis hucusque maxime crudis oblongis compressis glabris, pappo cupulari subevanido.

Hab. Lusitu River at 3000 ft.; in fl. April; n. 1867.

Planta saltem trispithamea. Foliorum limbus 1·5–2 cm. long., 6–10 mm. lat., firme membranaceus; petioli tenues, piloso-hirtuli, 5–10 mm. long. Cymæ ultraspithameæ. Pedunculi proprii vulgo 8–12 cm. long., erecto-ascendentes. Bracteæ spathulatæ, ± 1 cm. long. Involucri phylla exteriora 2–3·5 mm., interiora 4·5–5 mm. long.; illa 1·6–2 mm. lat., hæc 1·5 mm. Receptaculi paleæ 3·5–4 mm. long. Ligulæ angustissime ovato-oblongæ, subobsolete 3-dentatæ, 4-nerves, 6 × 1·75 mm. Disci corollæ 4 mm. long. Styli rami 0·5 mm. long. Achænia longit. 1 mm. paullulum excedentia.

Near *S. candelabrum*, O. Hoffm.. but laxer in habit, with smaller leaves and different involucres.

S. FLEXUOSUM, *Hutch. in Kew Bull.* 1906, 249.

Chimanimani Mts. at 7000 ft.; in fl. Sept.; n. 1866.

Distrib. Nyasaland.

WEDELIA MENOTRICHE, *Oliver & Hiern, in Fl. Trop. Afr.* iii. 377.

Lower Umswirizwi River, 1000 ft.; in fl. Nov.; n. 316 *a*.

Distrib. East Tropical Africa.

ASPILIA BRACHYPHYLLA, *S. Moore*, sp. nov.

Herbacea, caule ascendente sursum ramoso scabrido-pubescente dein scabriusculo, foliis ad normam generis parvis brevipetiolatis oblongo-ovatis acutis basi obtusissimis nisi rotundatis margine distanter serrulatis firme membranaceis supra pilis strigillosis scaberrimis subtus scabridis, capitulis mediocribus ad apicem ramulorum paucis (sæpissime 2–3) corymbum brevem constituentibus, pedunculis propriis hispidulo-scaberrimis involucrum manifeste excedentibus, involucri 3-serialis quam discus brevioris phyllis inter se subæqualibus oblongo-lanceolatis acutis pagina utraque scaberrimis superne herbaceis, receptaculi paleis anguste obovato-oblongis sursum subito cuspidato-acuminatis apice acutis juxta cuspidem ciliolato-erosulis superne scabriusculis, ligulis circa 10 anguste oblongo-obovatis apice bilobis flavis, achæniis compressiusculis fere omnino epunctatis superne sericeo-puberulis cupula setis orba ore ciliato-terminata.

Hab. Chirinda, a common weed in cultivated ground; in fl. May; nos. 292, 495.

Foliorum adultorum limbus vulgo 2–3·5 cm. long., 1–2 cm. lat., trinervis, in sicco supra fuscus subtus olivaceus; petioli circa 2 mm. long. Corymbi summum 3 cm. long. Capitula pansa 2 cm. diam. Involucrum 10 × 12 mm.; phylla 9 mm. long., 2·5–3 mm. lat., perpauca intima membranacea. Receptaculi paleæ papyraceæ, multinerves, 9 mm. long. Ligula (lamina) vix 1 cm. long. Disci flosculi usque ad 7 mm. long. Achænia 4 × 2 mm., griseola; pappus 0·75 mm. long.

To be placed next the West African *A. Smithiana*, Oliv. & Hiern, which it greatly resembles. The chief differences are the larger heads of the plant just described, its longer and broader involucral leaves, and the cuspidate-acuminate receptacular paleæ.

A. ASPILIOIDES, *S. Moore*, comb. nov.
Coreopsis aspilioides, Baker, in Kew Bull. 1898, 153.
Lower Umswirizwi River, 1000 ft.; in fl. Nov.; n. 316.
Distrib. Nyasaland.

MELANTHERA SWYNNERTONII, *S. Moore*, sp. nov.

Herba diffusa caule tetragono scabrido dein scabriusculo, foliis petiolatis lanceolatis vel lanceolato-oblongis nonnunquam ima basi lobulatis sursum attenuatis apice acutis basi obtusis truncatisve margine serratis papyraceis utrinque scabris, capitulis ∞-flosculosis corymbum brevem oligocephalum formantibus, pedunculis propriis capitula multo excedentibus gracilibus scabridis, involucri 3-serialis scaberrimi phyllis seriei I. & II. ovato-oblongis vel ovato-lanceolatis acutis breviterve acuminatis coriaceis sursum herbaceis quam illa seriei III. tenuia oblongo-obovata acuta plane longioribus, receptaculi paleis oblongis apice late triangularibus ipso breviter mucronatis superne

scaberrimis, radii flosculis ♀, ligulis circiter 15 involucrum longe excedentibus anguste ovato-oblongis apice subobsolete denticulatis, achæniis crudis abbreviatis cylindrico-turbinatis margine apicali sericea exempta glabris, pappi paleis 15–16 scabridis caducis.

Hab. Chibabava, Lower Buzi, 400 ft.; fl. Nov.; n. 1882.

Foliorum limbus usque ad 13 cm. long., 3 cm. lat. (exstant vero folia alia præsertim juvenilia multo minora), trinervis, in sicco pagina superiore olivaceus, inferiore pallidior; petioli 8–15 mm. long., scaberrimi. Corymbus unicus nobis obvius e capitulis tribus sistens, a basi ramosus; pedunculi proprii 3·5–4·5 cm. long. Involucri phylla longiora vix adusque 6 mm. long.; intima 4 mm. Receptaculi paleæ 5 mm. long. Ligulæ 12 × 5·5 mm., flavæ. Disci corollæ 4 mm. long. Achænia paullulum ultra 1 mm. long.; pappi paleæ inter se inæquales, sordide albi, 0·5–2·5 mm. long.

Can be easily distinguished from *M. Brownei*, Sch. Bip., by the long and narrow leaves, the shortly pointed paleæ of the receptacle, and the pappus.

MELANTHERA BROWNEI, *Sch. Bip. in Flora*, xxvii. (1844) 673.

Near Chirinda, at 3500 ft.; fl. Oct.; nos. 293, 294.

Distrib. Tropical Africa and Northern South Africa.

GUIZOTIA EYLESII, *S. Moore, in Journ. Bot.* xlvi. (1908) 43.

Near Chirinda, 3800 ft.; Lower Umswirizwi River, 1000 ft.; Kurumadzi River, Jihu, 2000 ft.; in fl. May, Aug., Nov.; nos. 295, 489, 1883, 1945.

Distrib. Rhodesia.

BIDENS PROLIXUS, *S. Moore*, sp. nov.

Herba fere metralis caule ascendente deorsum simplici paucifolioso quadrangulari glabro, ramulis sat gracilibus pilosis, foliis parvis plane petiolatis vel subsessilibus pinnatisectis segmentis pinnatifidis ambitu lanceolatis vel lanceolato-ovatis margine serrato-dentatis pilosis vel fere omnino glabris, capitulis parvis in corymbum folia longe excedentem oligocephalum laxum dispositis, pedunculis propriis elongatis attenuatis pilosis, involucri phyllis exterioribus linearibus obtusis superne herbaceis quam interiora ovato-oblonga obtusa paullo brevioribus omnibus dorso strigoso-scabridis, ligulis circa 8 bene exertis oblongis obtusissimis, achæniis angustis compressis apice ipso levissime contractis striatis scabridis vel scabriusculis setis 2 brevibus retrorsum aculeolatis coronatis.

Hab. Melsetter 200–600 ft.; in fl. & fr. April; n. 1884.

Folia 2–5 cm. long.; segmenta usque ad 2·5 cm. long., sæpissime vero breviora et 3–6 mm. lat., glandulis fuscis majusculis inspersa; petioli 2–30 mm. long., plus minus pilosi. Corymbi sæpius 12–15 cm. long.; pedunculi proprii vulgo 4–7 cm. long. Capitula pansa 1·5 cm. diam. Involucrum basi crassiusculum, pilis strigosis brevibus munitum; phylla

exteriora 2·5 mm. long., interiora 4 mm. long. Ligulæ 1 cm. long., 2·25 mm. lat., multinerves. Disci flosculi 3·5 mm. long. Achænia nunc brevia nunc longa, illa 4–5 mm., hæc 7 mm. long., omnia 1 mm. lat., liventia.

Differs from *B. Schimperi*, Sch. Bip., in its slender habit with long-stalked scattered heads, its smaller leaves with narrower lobes, its smaller heads, shorter involucres, and narrower ligules.

HYPERICOPHYLLUM ELATUM, *N. E. Br. in Journ. Linn. Soc.* xxxv. (1902) 122.

Chipetzana River, 3000 ft.; in fl. April; n. 1816.

Distrib. Tropical East Africa from Zanzibar southward.

SCHISTOSTEPHIUM HEPTALOBUM, *Benth. & Hook. f. ex Oliver & Hiern, in Fl. Trop. Afr.* iii. 399.

Near Chirinda, 3500 ft.; Melsetter, 6000 ft.; in fl. May, Sept.; nos. 491, 1808.

Distrib. Zambesia, South Africa.

SCHISTOSTEPHIUM OXYLOBUM, *S. Moore*, sp. nov.

Fruticulus ramis crebro foliosis gracilibus rigidis subteretibus pubescentibus deinde glabrescentibus, foliis circuitu obovatis vel obovato-oblongis pinnatisectis segmentis solemniter 3–4-jugis lineari-oblongis integris vel apice 2–3-dentatis segmento terminali majore oblongo-obovato dentibus sæpissime 3–5 apicalibus induto (dentibus omnibus acutis) puberulis novellis albo-pubescentibus, capitulis mediocribus homogamis circa 40-flosculosis corymbos satis abbreviatos bracteatos nunc oligo- nunc pleiocephalos referentibus, involucri subhemisphærici appresse sericeo-pubescentis phyllis 4-serialibus exterioribus oblongo-lanceolatis acutis vel acutiusculis quam anteriora oblongo-spathulata obtusa apice piloso-ciliata brevioribus omnibus margine anguste scariosis, receptaculo convexiusculo nudo, flosculis levissime exsertis, corollis 4-lobis, achæniis haud maturis compressis tricostatis glabris cupula fere obsoleta onustis.

Hab. Chimanimani Mountains at 7000 ft., Mt. Pene, 7000 ft.; in fl. Sept., Oct.; nos. 1871, 6132.

Folia profecto evoluta usque ad 2·5 cm. long. et 1·0–1·5 cm. lat., subtus glandulis fuscis creberrime inspersa, in sicco olivaceo-fusca; lobi vulgo 7–10 mm. long., summum circa 3 mm. lat., dentes triangulares, 1–1·5 mm. alt.; petioli attenuati, 3–4 mm. long. Corymbi uberiores 3 × 3·5 cm., depauperati interdum capitula modo 5 includentes 1·5 × 1·5 cm. Bracteæ inferiores foliis subsimiles nisi multo minores, summæ maxime imminutæ, filiformes, 2–3 m. long. Pedunculi proprii solemniter 5–7 mm. long. Capitula ægre 6 mm. diam. Involucri phylla exteriora 1·5–2 mm., interiora 2·5 mm. long. Receptaculum 2·2 mm. diam. Corollæ 2 mm. long.; lobi

0·6 mm. Styli rami 0·3 mm. long. Achænia 1·6–1·9 mm. long., sæpe aliquanto curvata.

Easily distinguished from the preceding by the peculiar lobing of the leaves.

MATRICARIA HISPIDA, *Vatke, in Oest. Bot. Zeitschr.* xxvii. (1877) 194, ex descript.

Open woods at Beira ; fl. Dec. ; n. 1872.

Distrib. East African tropical coast-region.

ARTEMISIA AFRA, *Jacq. Hort. Schœnb.* iv. 34.

Near Chirinda, 3700 ft.; Melsetter at 6000 ft.; Lusitu and Nyahodi Rivers; in fl. July ; nos. 446, 646, 646 *a*, 646 *b*, 1822.

Distrib. East and South tropical Africa and South Africa.

LOPHOLÆNA BRICKELLIOIDES, *S. Moore*, sp. nov.

Frutex grandis, glaber, ramulis ascendentibus teretibus striatis, foliis dispersis petiolatis oblongo-ovatis lateve obovato-oblongis obtusissimis basi nunc truncato-rotundatis nunc in petiolum sensim desinentibus crassiusculis uninervibus, capitulis pro rata parvis 7-flosculosis in paniculam sat magnam polycephalam bracteatam dispositis, involucri tandem campanulato-cylindrici phyllis oblongo-linearibus acutis margine scariosis dorso haud appendiculatis cito disjunctis sed ima basi paullo incrassatis ibique connatis, flosculis exsertis, antheris basi brevissime sagittulatis, styli ramis elongatis oblongo-linearibus obtusiusculis dorso hirtulis, achæniis obscure 5-gonis 5–6-costatis sericeo-hirtellis, pappi setis permultis scabridis albis.

Hab. In crags of the Chimanimani Mountains, 7000 ft.; Mt. Pene, 7000 ft.; in fl. Sept., Oct. ; nos. 1802, 6133.

Foliorum limbus in sicco olivaceus, 4–8 cm. long., 2·5–5 cm. lat. (folia summa vero in bracteas gradatim transeuntia), apice nonnunquam retusus ; costa centralis solum perspicua, foliorum vetustiorum petioli 2–3·5 cm. long. Panicula adusque 20 × 14 cm. ; hujus bracteæ ambitu foliis similes vulgo 1–2·5 cm. long., summæ equidem minores. Pedunculi proprii 0–3 mm. long. Involucra 1 cm. long., primo 4 mm. deinde usque ad 8 mm. lat. ; phylla 1·2–1·7 mm. (raro 2·2 mm.) lat., omnino plana leviterve carinulata. Flosculi dilute purpurei. Corolla in toto 9 mm. long. ; tubus inferne 0·6 mm., parte intermedia 0·3 mm., superne ægre 1 mm. diam. Styli rami exserti, fere 2 mm. long. Achænia 5 × 1·2–1·5 mm., pallidissime lutescentia, basi fulvida. Pappi setæ 6–8 mm. long.

A very distinct plant with leaves, except for their being stalked, much like those of *L. platyphylla*, Benth., and thus quite different from the two species (*L. cneorifolia* and *L. dolichopappa*) with heads of small size.

SENECIO PROPIOR, *S. Moore*, sp. nov.

Herbacea verisimiliter 1½–2-spithamea caule ascendente simplici vel rare ramoso in longitudinem eximie costato glabro vel leviter araneoso, foliis

radicalibus paucis longe ac graciliter petiolatis ut caulina sessilia nonnumquam basi auriculata et breviter amplexicaulia linearibus (superioribus anguste linearibus) apicem versus attenuatis apice ipso obtusis margine revolutis integris subobsoleteve calloso-denticulatis coriaceis glabris vel obscure araneosis, capitulis submediocribus heterogamis radiatis multiflosculis in corymbum brevem bracteatum oligocephalum laxe araneosum digestis, pedunculis propriis plerumque involucra æquantibus vel superantibus, involucri campanulati phyllis 15–19 subbiserialibus oblongis sursum triangularibus apice acutis margine membranaceis leviter araneosis nisi glabris, calyculi phyllis circa 10 sat longis anguste linearibus acutis, ligulis circa 8 luteis bene ex involucro eminentibus, disci flosculis circiter 40 breviter exsertis, styli ramis truncatis penicillatis, achæniis hucusque crudis cylindricis striatis sericeo-puberulis, pappi setis scabriusculis albis.

Hab. Chimanimani Mountains at 7000 ft.; fl. Sept.; n. 1879.

Folia radicalia circa 10 cm. long., 5 mm. lat.; horum petiolus 6 cm. long.; folia caulina solemniter 7–15 cm. long., 3–7 mm. lat., juniora vero imminuta in corymbi bracteas transeunt, auriculæ dum adsint margine denticulatæ. Corymbi modice 10 cm. long., 5–7 cm. diam. Capitula pansa 7 × 13 mm. Involucri phylla 7 mm. long., calyculi 4–5 mm. Ligulæ angustissime ovato-oblongæ, tridenticulatæ, 7-nerves, 6·5 mm. long. Disci corollæ 5 mm., styli rami 1·2 mm., achænia 1·2 mm., pappi setæ usque ad 5 mm. long.

Very close to *S. albanensis*, DC., from which it can be distinguished chiefly by the leaves which are sometimes auricled at the base, the more closely arranged smaller heads and the silky-puberulous (not glabrous) achenes.

SENECIO LATIFOLIUS, *DC. Prod.* vi. 387.

Near Chirinda at 4000 ft.; in fl. Nov.; nos. 1876, 1944.

Distrib. South Africa extending to Nyasaland and Angola.

SENECIO TRIACTINUS, *S. Moore*, sp. nov.

Herbaceus, verisimiliter aliquanto elatus, caule erecto folioso striato minute puberulo dein glabro, foliis radicalibus ignotis caulinis subsessilibus anguste ovato-oblongis apice mucronatis basi obtusis vel subrotundatis margine dentato-serrulatis serraturis mucronatis obscurissime trinervibus papyraceis pagina utraque glabris, capitulis parvis heterogamis radiatis circa 17-flosculosis paniculam elongatam corymbiformem pleiocephalam bracteatam laxiusculam piloso-puberulam referentibus, involucri campanulati phyllis 8 oblongis superne deltoideis apice obtusis vel acutis margine membranaceis glabris, calyculi phyllis perpaucis abbreviatis subulatis, ligulis 3 albis ut disci flosculi plane exsertis, styli ramis truncatis penicillatis, achæniis hucusque crudissimis cylindricis piloso-puberulis, pappi setis scabriusculis albis.

Hab. Jihu, Kurumadzi River, 2000 ft.; in fl. Nov.; n. 1878.

Folia 6–7 cm. long., 2–2·5 cm. lat., in sicco griseola ; costa media utrinque prominens etsi tenuis, ordinis secundi costarum jugum basale erecto-ascendens, costæ ceteræ patulæ ; reticulum paginæ inferioris eximie aspectabile ; petioli summum 2 mm. long. fere totidem lat. Bracteæ inferiores lanceolatæ vel lineares, ±2·5 cm. long., superiores adusque 2 mm. gradatim diminutæ. Capitula pansa 1 cm. diam. Involucri phylla 3·5–4 mm. long., calyculi 1·2 mm. Panicula 20–30 cm. long., 15–20 cm. diam. ; pedunculi partiales erecto-ascendentes, gracillimi, modice 2 cm. long. ; pedunculi proprii ±1 cm. long. Ligulæ anguste oblongo-obovatæ, apice brevissime denticulatæ, 6–8-nerves, 4 mm. long. ; disci corollæ 4·5 mm. long. Genitalia breviter exserta. Styli rami 1 mm. long. Achænia 1·5 mm., pappi setæ 4·5 mm. long.

The affinity is with *S. crenatus*, Thunb., which has stalked leaves different in shape and venation, shorter and more crowded panicles, larger heads with broader involucral leaves, 4–5 yellow ray-florets, &c. *S. colensoensis*, O. Hoffm., I know only by the description, which is that of a plant with differently shaped leaves, 12 involucral leaves and 5 white florets of the ray.

SENECIO HOMOPLASTICUS, *S. Moore*, sp. nov.

Herba elata caule erecto pluristriato saltem superne crebro folioso primo subobsolete araneoso novellis albo-araneosis, foliis radicalibus—caulinis subsessilibus anguste ovato-lanceolatis vel oblongo-ovatis acutis apice mucronatis basi rotundatis margine serratis serraturis mucronatis membranaceis cito glabris, capitulis parvis heterogamis radiatis circa 33-flosculosis paniculam corymbosam satis elongatam pleiocephalam bracteatam plus minus araneosam mox puberulam efformantibus, pedunculis propriis gracilibus involucra sæpissime saltem æquantibus, involucri campanulati phyllis 10–12 subbiserialibus oblongis acutis margine membranaceis calyculi phyllis paucissimis subulatis quam involucrum multo brevioribus, ligulis 5 flavis exsertis, disci flosculis ita exsertis circiter 28, styli ramis truncatis penicillatis, achæniis valde immaturis cylindrico-turbinatis pubescentibus, pappi setis scabriusculis albis.

Hab. Near Chirinda, 3500 ft. ; in fl. Oct. ; n. 288.

Folia 4·5–6 cm. long., circiter totidem lat., in sicco olivaceo-brunnea, basi levissime trinervia ; costa media utrobique eminens, reticulum elegantulum pagina inferiore solummodo visum; petioli 2 mm. long. et lat. Panicula 8–14 cm. long., circiter totidem lat.; pedunculi partiales inferiores summum fere 10 cm. long. ; pedunculi proprii plurimi 4–14 mm. long. Bracteæ vetustiores ±1·5 cm. long., juniores 2·5–5 mm. Capitula pansa circiter 1 cm. diam. Involucra 4·5 × 5 mm. ; calyculi phylla 2·5 mm. long. Ligulæ late oblongæ, apice 2–3-denticulatæ, 6–8-nerves, 5 mm. long. Disci corollæ 5·5 mm. long. Achænia 1·25 mm., pappi setæ 4·5 mm. long.

Homoplastic with the foregoing, but the panicles are shorter and denser, the involucres have a greater number of longer leaves, and each head has 5 yellow ligules and about double as many disc-florets as the other.

Var. TOMENTELLUS, *S. Moore*, var. nov. A typo discrepat caulibus necnon paniculis fulvo-tomentellis. With the type form at Chirinda ; n. 288 *a*.

The ligules appear to be deeper in colour than those of the type specimens.

SENECIO ACERVATUS, *S. Moore*, sp. nov.

Frutex altus vel arbuscula ramulis incrassatis verisimiliter solummodo foliosis in sicco longitrorsum sulcatis puberulis mox glabris, foliis oblongo-lanceolatis obtusis basi in petiolum longe attenuatis margine calloso-dentatis crassiusculis supra glabris subtus brunneo-pubescentibus cito puberulis, capitulis parvis homogamis discoideis 8–11-flosculosis in paniculas terminales sat elongatas pedunculatas subthyrsoideas pleistocephalas bracteatas primo dense brunneo-pubescentes digestis, pedunculis propriis involucra sæpius circiter æquantibus pubescentibus, involucri late cylindrici phyllis 6–7 oblongis apice deltoideis ipso obtusis acutisve omnimodo glabris margine membranaceis adjectis calyculi phyllis perpaucis parvulis setaceis, flosculis plane exsertis luteis, styli ramis truncatis penicillatis, achæniis maxime crudis subcylindricis ipso apice dilatatis puberulis, pappi setis scabriusculis albis.

Hab. Chirinda Forest, 3700–4000 ft. ; in fl. Oct. ; n. 665.

Folia 8–14 cm. long., 2·5–3 cm. lat., in sicco fuscescentia; costæ ordinis secundi numerosæ, sæpissime ad angulum fere rectum costæ centrali crassæ insertæ ; petioli solemniter 2–4 cm. long., crassiusculi, puberuli. Panicula summum 20 cm. long. ; pedunculus communis 4–7 cm., pedunculi partiales inferiores 3·5–7 cm., pedunculi proprii ±3·5 mm. long. Bracteæ ±2 mm. long., ultimæ in calyculi phylla circiter 1 mm. long. transeuntes. Capitula 6 × 2·5 mm. Involucri phylla 4 mm. long, 1·3–2 mm. lat., in medio fusca marginibus stramineis. Corollæ dimidio superiore leviter amplificatæ, 5 mm. long. Styli rami 1 mm. long. Achænia ægre 1 mm. long., pappi setæ 4–5 mm.

Nearly allied to *S. multicorymbosus*, Klatt, from which it can be distinguished at first sight by its much smaller fewer-flosculed heads with only 6–7 shorter and broader leaves to their involucres.

SENECIO GAZENSIS, *S. Moore*, sp. nov.

Herbacea, perennis, caule simplici erecto rigido satis gracili quadrangulari inferne albo-pubescente superne leviter araneoso, foliis arrectis primo confertis sessilibus anguste linearibus acutis pungentibus nonnunquam uncinulatis subplanis integris rarius sub apice minute denticulatis paucis summis imminutis in calyculi phylla transeuntibus, capitulis parvis heterogamis radiatis 20-flosculosis in corymbum oligocephalum folia plane excedentem dispositis, involucri campanulati phyllis 8 anguste ovato-oblongis superne coartatis apice obtusis vel obtuse acutis margine membranaceis fere omnino glabris additis calyculi phyllis perpaucis parvulis lineari-subulatis quam involucrum multo brevioribus, ligulis circa 4 ex involucro eminentibus luteis, disci flosculis exsertis, styli

ramis truncatis penicillatis, achæniis subcylindricis 6-costatis glabris, pappi setis scabridis albis.

Hab. Melsetter at 6000 ft.; in fl. Oct.; n. 6143.

Folia solemniter 8–12 mm. long., circa 1 mm. lat., (ultima modo 2·5–4 mm. long.), dorso carinata vel carinulata facie leviter excavata subplanave. Corymbus exemplaris unici nobis obvii 7-cephalus, 4·5 × 3 cm.; pedunculi proprii inferiores ±15 mm., superiores 5 mm. long.; calyculi phylla 2 mm. long. Involucri 4 mm. long. phylla coriacea, dorso microscopice puberula, apice leviter barbellata. Ligulæ anguste ovato-oblongæ, apice tridentatæ, 4 mm. long. Disci florum corollæ 4 mm. long. Achænia 2 mm., pappus 4 mm. long.

The position of this is in the § *Leptophylli* near *S. filifolius,* Harv., from which it differs in leaf, inflorescence, involucre, &c.

The specimen is not a very satisfactory one, and some doubt attaches to the number of ligules until further material comes to hand.

SENECIO TAMOIDES, *DC. Prod.* vi. 403.
Chipete Forest Patch, 3800 ft.; n. 1877.
Distrib. Natal.

S. DELTOIDEUS, *Less. Syn.* 392.
Chirinda, 3700–4000 ft.; Chipete Forest Patch, 3800 ft.; Mts. Maruma and Pene; fl. Feb., June, Sept., Oct.; nos. 288, 288 *a*, 1873, 6131.
Distrib. Nyasaland, S. Africa.

S. OXYRIÆFOLIUS, *DC. Prod.* vi. 405.
Chimanimani Mts. at 7000 ft.; in fl. Sept.; n. 1946.
Distrib. S. Africa.

S. ERUBESCENS, *Ait. Hort. Kew.* ed. 1, iii. 190.
Chirinda at 3700–4000 ft.; fl. Nov.; n. 1812.
Distrib. Africa from Angola and Nyasaland southward.

CINERARIA LOBATA, *L'Hérit. Sert. Angl.* 26.
Melsetter, 6000 ft.; in fl. Sept.; n. 1875.
Distrib. A South-African plant reaching northward to Nyasaland.

HAPLOCARPA SCAPOSA, *Harv. Fl. Cap.* iii. 465.
Mt. Maruma, 3500 ft.; in fl. Sept.; n. 1811.
Distrib. South Africa and on to Nyasaland and Angola.

GAZANIA KREBSIANA, *Less. Syn.* 44. Var. HISPIDULA, *Harv. Fl. Cap.* iii. 476. Mt. Pene; fl. Oct.; n. 6115.
Distrib. Rhodesia and South Africa.

BERKHEYA SETIFERA, *DC. Prod.* vi. 507. Var. TROPICA, var. nov.

A typo abhorrens ob folia obovato-oblanceolata, dentato-lobulata vel pinnatifida, usque ad 19 × 4·5 cm. long., ovaria angustiora (vix 0·5 mm. lat.), pappi setas pauciores et leves.

Hab. Hills overlooking Lusitu River at 5000 ft.; in fl. Sept.; n. 1869.

Distrib. (of type). S. Africa.

B. ZEYHERI, *Oliver & Hiern, in Fl. Trop. Afr.* iii. 429.

Hills near Haroni River, 5600 ft.; Melsetter, 6000 ft.; fl. Sept., Oct.; nos. 1868, 6114.

Distrib. A South-African plant ranging northward to Nyasaland.

TRIPTERIS MONOCEPHALA, *Oliver & Hiern, in Fl. Trop. Afr.* iii. 424.

Mt. Pene at 7000 ft.; fl. Oct.; n. 6161.

Distrib. Nyasaland and Zambesia.

T. AMPLEXICAULIS, *Less. Syn.* 90.

Mt. Pene at 6500–7000 ft.; in fl. Sept.; n. 1859.

Distrib. Angola, Rhodesia, and South Africa.

OSTEOSPERMUM MONILIFERUM, *Linn. Sp. Pl.* 923.

Melsetter, 6000 ft.; near Chirinda, 3500 ft.; Mt. Pene; hills near Haroni River at 5000 ft.; fl. May, Sept., Oct.; nos. 497, 1858, 1858 *a*, 6130.

Distrib. A South-African plant extending into the tropic as far as German East Africa.

ERYTHROCEPHALUM ZAMBESIANUM, *Oliver & Hiern, in Fl. Trop. Afr.* iii. 441.

Open woods near Chirinda, Kurumadzi River, Jihu, 2000 ft.; in fl. Oct., Nov.; nos. 236, 1825.

Distrib. Nyasaland and Zambesia.

DICOMA ANOMALA, *Sond. in Linnæa,* xxiii. (1850) 71.

Northern Melsetter; fl. April; n. 1818.

Distrib. Tropical East Africa, South Africa.

D. KIRKII, *Harv. Fl. Cap.* iii. 518. Var. ANGUSTIFOLIA, *S. Moore*, var. nov.

A typo non discrepat nisi foliis adusque 5–10 mm. angustata.

A tall herb found near Chirinda, 3800 ft.; fl. May; n. 444.

Distrib. (of type). Zambesia.

Monro's 413 and 1100 C from Victoria, Rhodesia, are referable to this variety.

GERBERA ABYSSINICA, *Sch. Bip. ex Hochst. in Flora,* xxiv. (1841) 27.

Mt. Pene, 6500–7000 ft.; fl. Sept., Oct.; nos. 1821, 6113.

Distrib. East and South tropical Africa.

Gerbera piloselloides, *Cass. in Dict. Sc. Nat.* xviii. 461.
Near Chirinda, 4500 ft.; fl. Nov.; n. 1870.
Distrib. East and South tropical Africa, South Africa, Madagascar, East Indies.

Sonchus Bipontini, *Aschers. in Schweinf. Beitr. Fl. Æthiop.* 160. Var pinnatifidus, *Oliver & Hiern, in Fl. Trop. Afr.* iii. 458.
Near Chirinda, 3800 ft.; fl. May; n. 1886.
Distrib. East tropical Africa.

CAMPANULACEÆ.

Lobelia decipiens, *Sond. in Fl. Cap.* iii. 540.
Mt. Pene at 6000 ft.; fl. Oct.; n. 6081.
Distrib. Rhodesia, South Africa.

Lobelia (§ Holopogon) cobaltica, *S. Moore,* sp. nov.
Herbacea, saltem bispithamea, ramis tenuibus hispidulis superne nudis, foliis alternis parvis ambitu nunc suborbicularibus nunc obovatis basi truncatis argute lobulato-crenatis lobulis mucronulatis petiolis alatis sat longis insidentibus utrinque sed præsertim pagina inferiore hispidis, racemis distanter paucifloris hispidulis, bracteis setaceis ut pedicelli eas ipsas paullulum excedentes hispidulis, ovario subhemisphærico hispido, calycis segmentis ovario plane longioribus subulato-setaceis sparsim hispidulis, corollis mediocribus calycem longe superantibus lobis anticis late obovatis obtusissimis dorso breviter hispidulis quam postici lineari-oblongi longioribus.
Hab. In crags of the Chimanimani Mountains at 7000 ft.; in fl. Sept.; n. 2036.
Foliorum limbus nunc 8×10 mm. nunc 8×6–7 mm.; petioli laminam semiæquantes, hispidi. Inflorescentia adjecta ramuli suffulcientis parte superiori nuda 10–20 cm. long. Pedicelli ± 5 mm., bracteæ summum 4 mm. long. Flores vivide cærulei. Ovarium vix 2 mm. long. Calycis segmenta 4–5 mm. long. Corollæ pars tubularis 9 mm. long.; labii 11 mm. long. lobus intermedius 6 mm., lobi laterales 5·5 mm. long.; lobi postici 5 mm. Tubus stamineus 6 mm. long., antheræ longiores 2·5 mm., breviores ægre 2 mm. long. Capsula ——.
This has to some extent the look of *L. hirsuta,* Linn., but its leaves are different in several respects; the flowers stand upon longer pedicels and the calyx-lobes are setaceous.

L. fervens, *Thunb. Fl. Cap.* 183.
Cultivated ground near Chirinda, 3800 ft.; fl. May; n. 513.
Distrib. East and South tropical Africa, South Africa.

Lobelia (§ Hemipogon) jugosa, *S. Moore*, sp. nov.

Herba spithamea vel infra caulibus pluribus paucifoliatis puberulis, foliis radicalibus vel subradicalibus obovatis-oblongis obtusis basi in petiolum cuneatim angustatis margine dentatis basin versus integris præsertim in nervis puberulis foliis caulinis distantibus sessilibus lineari-oblongis margine denticulatis, racemis elongatis distanter paucifloris gracilibus glabris, bracteis anguste linearibus quam pedicelli teneri multo brevioribus, ovario ovoideo 6-nervoso glabro, calycis segmentis subulatis acutis glabris ovario æquilongis, corollæ parvæ glabræ parte tubulari limbum breviter excedente limbi lobis anticis obovatis obtusissimis posticis oblongis æquilongis.

Hab. Hills between the Lusitu and Nyahodi Rivers at 5000 ft.; in fl. Sept.; n. 2037.

Folia radicalia ± 13 mm. long., 5–6 mm. lat.; petioli circa 5 mm. long.; caulina circa $10 \times 1{\cdot}5$ mm., juniora imminuta. Racemi ± 10 cm. long. Bracteæ ± 3 mm. long. Pedicelli tandem 15 mm. long. vel ultra. Flores cærulei. Ovarium 2 mm., calycis segmenta 2 mm. long. Corollæ pars tubularis 4 mm. long.; limbus 3 mm. long., hujus lobi antici $2 \times 1{\cdot}75$ mm., postici $2 \times$ fere 1 mm. Tubus stamineus vix 3 mm. long.; antheræ longiores dorso puberulæ, 1·75 mm. long., breviores apice dense barbatæ 1·5 mm. Capsula adhuc cruda cylindrica, 6 mm. long., 2·5 mm. lat.

To be compared with *L. benguellensis*, Hiern, and *L. rosulata*, S. Moore, which also have a rosette of radical leaves, but are both somewhat different in foliage and flower.

N. 6085 from Mount Pene appears referable to this species. It is a small specimen with but three flowers at the top of the slender single stem. Also n. 6080 may perhaps be a taller more matured state from which the radical leaves have fallen.

Lightfootia abyssinica, *Hochst. ex A. Rich. Fl. Abyss.* ii. 1.

Near Chirinda, 3800 ft.; fl. May; n. 515.

Distrib. Uganda to Rhodesia.

Wahlenbergia virgata, *Engl. Pflanzenw. Ost-Afr.* C. 400.

Melsetter; Mt. Pene, 6500–7000 ft.; fl. April, Sept.; nos. 2020, 2021.

Distrib. Tropical East Africa.

W. rhodesiana, *S. Moore*, sp. nov.

Herbacea, verisimiliter annua, semispithamea, copiose ramosa caule ascendente gracili ramos patentes ascendentesve emittente, ramulis gracillimis sparsim foliosis minute scabriusculo-puberulis, foliis sparsis alternis parvulis sessilibus filiformibus obtusis integris, floribus parvis partim terminalibus partim foliorum ex axillis oriundis cymam paucifloram laxam efficientibus, pedicellis filiformibus folia sæpissime subæquantibus, ovario campanulato-globoso fere omnino glabro, calycis lobis lineari-subulatis ovario

longioribus, corolla campanulata calycem bene excedente circa adusque medium divisa lobis oblongo-ovatis obtusis quam tubus paullo brevioribus, stylo leviter exserto, stigmatibus 3 brevibus, capsula subglobosa 3-valvi.

Hab. Melsetter, 5000–6000 ft.; in fl. & fr. Oct.; n. 6225.

Folia ±3 mm. long., solemniter circa 3 mm. Pedicelli vulgo 2–3 mm. long. Ovarium 1–1·5 mm., calycis lobi 2–2·5 mm., corolla 4·5 mm. long. Stylus 3·5 mm. long.; stigmata linearia, 0·6 mm. long. Capsula semisupera, 2 mm. long., 2·25 mm. diam.

A plant with the habit and much the appearance of *W. exilis*, A. DC. Its nearest affinity is with *W. mashonica*, N. E. Br., which, among other characters, is of taller and coarser growth, more sparingly branched, and has its flowers borne on longer pedicels. Flowers apparently white.

ERICACEÆ.

Erica (Euerica § Ceramia) thryptomenoides, *S. Moore*, sp. nov.

Suffruticosa caule ascendente lignoso subterete piloso-hispidulo ramulos sæpe dense foliosos piloso-hispidulos emittente, foliis solemniter ternis parvulis sessilibus ovatis acutis basi rotundatis marginibus sæpe leviter revolutis crassiusculis utrobique glabris, floribus parvis ad apicem ramulorum paucis umbellulatis, pedicellis attenuatis plerumque patentibus vel recurvis corollas excedentibus vel saltem æquantibus hispidulis, calycis 4-partiti segmentis triangulari-oblongis obtusiusculis margine sparsim ciliolatis, corollæ campanulato-urceolatæ albæ glabræ tubo quam lobi rotundati 4-plo longiore, staminibus 8 disco insertis filamentis breviter exsertis antheris paullo supra basin dorsifixis basi calvis poris loculos semiæquantibus, ovario pubescente, stylo corollam excedente attenuato glabro.

Hab. Chimanimani Mountains at 7000 ft.; in fl. Sept.; n. 647.

Folia ±2 mm. long. et 1·5 mm. lat., pagina inferiore quam superiore paullo pallidiora; costa media subtus prominens. Pedicelli sæpissime 2·5–3·5 mm. long.; bracteæ circa 1 mm. long. Calycis segmenta 1 mm. long. Corollæ tubus 3 mm. long., summum 2·7 mm. lat.; lobi 0·75 mm. long. Filamenta 3·2 mm. long., antheræ circa 1 mm. Ovarium vix 1 mm. diam. Stylus 4·5 mm. long.

Differs from *E. thymifolia*, Wendl., chiefly in the more compact habit, and the shape and colour of the corollas and their smaller lobes.

Erica (Euerica § Ceramia) lanceolifera, *S. Moore*, sp. nov.

Caule verisimiliter plus minus procumbente sat tenui piloso-hirtulo tandem fere glabro ramulos breves tenerrimos foliatos piloso-hirtulos crebro gignente, foliis parvulis sæpissime 3–4-nis sessilibus oblongo-lanceolatis acutis vel obtusis margine revolutis coriaceis supra piloso-hispidulis subtus griseis, floribus parvis ex axillis ramulorum summis oriundis in inflorescentiam

umbellato-capitatam subconfertis, pedicellis tenuibus corollas circa æquantibus bractea angustissime lineari juxta medium donatis pilosis, calycis 4-partiti segmentis corollis semiæquilongis lanceolatis acutis margine ciliatis, corollæ campanulato-urceolaris glabræ puniceæ lobis brevibus deltoideis obtusis erectis tandem leviter recurvis, staminibus florum a nobis scrutatorum 6–7 disco insertis antheris breviter exsertis paullulum supra basin dorsifixis oblongis appendicibus lanceolatis acutis cristulatis onustis, ovario depresse globoso puberulo, stylo sat longe exserto compressiusculo glabro.

Hab. Chimanimani Mountains at 7000 ft. ; in fl. Sept. ; n. 1288.

Folia circa 3 mm. long., in sicco 1 mm. lat. vel paullulum ultra, facie superiore olivacea, levissime nitida. Inflorescentiæ solemniter 1 cm. diam. Pedicelli 1·5–2 mm. long. ; horum bracteæ 1 mm. long. Calycis segmenta vix ultra 1 mm. long. Corolla 2 mm. long., deorsum 1·7 mm., faucibus 1·5 mm. diam. ; lobi 0·75 mm. long. Filamenta usque ad 2 mm. long. ; antherarum loculi 1 mm. long. ; appendices 0·4 mm. ; pori 0·6 mm. long. Ovarium 1 × 1·2 mm. ; stylus fere 4 mm.

In a letter received from Dr. Bolus, who was good enough to examine the heaths of the collection, the differences between this plant and *E. planifolia*, Linn., are summed up as follows :—(1) The umbellate-capitate inflorescence and shorter pedicels. (2) The clothing of longer non-glandular hairs. (3) The often 4-nate leaves. (4) The ovate-lanceolate acute (not setaceo-acuminate) sepals. (5) The smaller campanulate-urceolate (not cyathiform) corolla. (6) The anthers not or very slightly tapering to the base, and provided with narrow-cristate (not subulate-aristate) appendages.

ERICA (Euerica § Ceramia) PLEIOTRICHA, *S. Moore*, sp. nov.

Suffruticosa, crebro ramosa, ramis ramulisque sat attenuatis etsi rigidis glanduloso-hispidulis his copiose foliosis, foliis parvulis sæpissime ternis brevissime petiolatis ambitu oblongo-ovatis sed ob dimidia dua revoluta et appropinquantia convenientiave linearibus vel summum anguste lineari-lanceolatis acutis crassiusculis marginibus glanduloso-hispidulis exemptis glabris, floribus solitariis in axillis foliorum summorum ex ramulis ultimis ortorum positis, pedicellis gracilibus corollis circa æquilongis glanduloso-hispidulis, bracteis vulgo approximatis foliis similibus nisi minoribus, calycis 4-partiti segmentis lanceolatis acutis glanduloso-ciliatis erectis, corollæ urceolatæ calycem bene excedentis glabræ dilute puniceæ lobis abbreviatis tandem recurvis deltoideo-rotundatis obtusissimis, staminibus 8 disco insertis antheris ex corolla breviter eminentibus levissime scabriusculis juxta basin dorsifixis aristis necnon poris longitudine dimidium loculi circa æquantibus, ovario piloso-pubescente, stylo exserto crassiusculo fere omnino glabro.

Hab. Chimanimani Mountains at 7000 ft. ; in fl. Sept. ; n. 648 *a*.

Folia 1·5–2 mm. long., circa 0·5 mm. lat. (explanata summum 1·5 mm.), subnitida, in sicco læte virentia. Bracteæ circa 1 mm. long. Pedicelli

plerique 2–3 mm. long. Calycis segmenta 1 mm. long., dilute punicea, apice viridia. Corolla $2·8 \times 3$ mm.; lobi ægre 1 mm. long. Filamenta 1·5 mm. long., antherarum loculi 0·75 mm. Ovarium 1×1 mm.; stylus 2·5 mm. long., ima basi leviter puberulus.

Near *E. trichoclada*, Guthrie & Bolus, from which it differs chiefly in the slenderer habit, hispidulous (not hispid) indumentum, shorter usually revolute leaves, corollas with relatively shorter and much broader lobes and exserted stamens.

ERICA (Euerica § Hermes) SWYNNERTONII, *S. Moore*, sp. nov.

Frutex ascendens glaber ramis prolixis rigidis ramulis dense foliosis filiformibus, foliis sparsis vel 2–3-nis angustissime lineari-lanceolatis sursum acicularibus dorso sulcatis in sicco griseo-viridibus, floribus ex axillis ramulorum superioribus solitatim ortis, pedicellis corollas plane excedentibus mox decurvis, bracteis juxta medium pedunculum 2 oppositis vel suboppositis linearibus acutis, calycis 4-partiti segmentis ovatis acuminatis margine obscure ciliolatis cito reflexis, corollæ calycem facile excedentis urceolatæ lobis ovatis obtusis, staminibus 8 disco insertis antheris inclusis oblongis basi dorsifixis poris loculis suis semiæquilongis cristis aristæformibus quam loculi 4-plo brevioribus, ovario glabro, stylo leviter exserto, stigmate capitato.

Hab. Melsetter, growing in the centre of a stream amongst rocks at 6000 ft.; hills between Lusitu and Nyahodi Rivers at 5000 ft.; Chimanimani Mts. at 7000 ft.; in fl. April, Sept.; nos. 648, 1063, 1064, 1065.

Planta saltem metralis. Folia sæpissime 1–1·2 cm. long., in sicco 0·5–0·7 mm. lat. Pedicelli graciles, colorati, ± 8 mm. long. Bracteæ 3–4 mm. long. Flores vivide punicei. Calycis segmenta 2 mm. long. Corolla $4 \times 3·5$ mm.; lobi 1·25 mm. long. Filamenta 2·5 mm. long.; antheræ ægre 1 mm. long., harum cristæ 0·2 mm. long. Ovarium globosum, 1·75 mm. long.; stylus 3 mm. long.

Close to *E. Whyteana*, Britten, which it much resembles on a first view; the leaves, however, are longer and the pedicels markedly so, the calyx-lobes are broader, the corollas larger with somewhat larger lobes, and the anthers, while longer and different in shape, have awn-like instead of broad appendages.

PHILIPPIA SIMII, *S. Moore*, sp. nov.

Arbuscula, ramulis ultimis gracilibus apice foliosis alibi saltem in sicco nudis nodulosisque glabris, foliis imbricatis solemniter 3-natim verticillatis lineari-oblongis obtusis dorso sulcatis margine obscure ciliato-denticulatis crassiusculis glabris in sicco læte viridibus, umbellis terminalibus sessilibus 2–3-floris, pedicellis calycem æquantibus vel paullo excedentibus glabris, calycis 4-fidi glabri lobis inter se subæqualibus ovatis obtusiusculis margine

microscopice ciliolatis crassiusculis, corollæ circa usque ad medium partitæ tetrameræ calycem excedentis lobis late ovatis obtusissimis, staminibus 8 antheris oblongis bifidis subinclusis, ovario subgloboso glabro 4-loculo, stylo bene exserto, stigmate peltato, ovulis quoque in loculo paucis.

Hab. Melsetter at 6000 ft.; fl. Oct.; n. 612. [Also Portuguese East Africa, abundant on wet sandy flats near Bajon Magenja da Costa; *Sim in hb. Bolus*, 5688.]

Ramuli ultimi modo 0·2 mm. diam. Folia (incluso petiolo 0·2 mm. long.) 1·5–2 mm. long., 0·5 mm. lat. Pedicelli plerique 1–2 mm. long. Calyx 1 mm., corollæ 1·5 mm. long. Filamenta complanata, 0·4 mm. long.; antheræ 1 mm., lobi 0·25 mm. long. Ovarium fere 1 × 1 mm. Stylus vix 1·5 mm. long. Stigma ægre 1 mm. diam.

Nearest *P. milanjiensis*, Britt. & Rendle, from which it can be distinguished by the leaves and exserted style.

This is one of the two common trees on the wind-swept slopes of the higher hills overlooking Melsetter, where it attains to about 15 feet.

PHILIPPIA HEXANDRA, *S. Moore*, sp. nov.

Arbuscula ramis sat validis cortice rubiginoso-cinereo rimoso obducto, ramulis tenuibus dense foliosis pubescentibus, foliis plerumque 3–5-natim verticillatis linearibus obtusis dorso alte sulcatis crassiusculis pubescentibus, floribus parvis in umbellas terminales sessiles paucifloras digestis, pedicellis calyce sæpissime brevioribus pubescentibus, calyce 4-fido pubescente lobo unico ovato sursum angustato quam reliqui late oblongi majore lobis omnibus pubescentibus necnon marginibus ciliatis, corolla calycis lobos minores excedente breviter 4-loba lobis subrotundatis obtusissimis, staminibus 6 antheris oblongis bifidis paullulum exsertis, ovario subgloboso incano-tomentoso 4-loculo, stylo sat gracili ovario paullulum longiore glabro, stigmate peltato obscure lobulato, ovulis quoque in loculo 3.

Hab. Melsetter and Northern Melsetter, 5000–6500 ft.; fl. Oct.; nn. 1147, 6072.

A small tree 30 feet high. Rami ultimi circa 0·4 cm. diam., ramuli 0·04 cm. Folia deorsum paullo ampliata, 2·5 mm. long., 0·75 mm. lat., in sicco olivacea, verticillis approximatis ita folia sat arcte imbricata. Pedicelli ±0·5 mm. long. Calyx 0·8 mm. long.; lobus major 1·4 mm. long. Corolla tota 1·2 mm. long., lobi circa 0·3 mm. Filamenta complanata, 0·6 mm. long.; antheræ 0·75 mm. long., harum lobi circa 0·2 mm. long. Ovarium 0·7 × 0·5 mm.; stylus 0·75 mm. long.; stigma 0·5 mm. diam. Capsula subglobosa, 2·5 × 2·25 mm.

Easily distinguished from *P. milanjiensis*, Britten & Rendle, by the longer hairy leaves, the hexandrous flowers, small stamens, and longer slender style.

PRIMULACEÆ.

ANAGALLIS HANNINGTONII, *Baker in Kew Bull.* 1901, 127.

Chipetzana River, 3000 ft.; in fl. & fr. Dec.; n. 357.

Distrib. South-East tropical Africa.

MYRSINEÆ.

MÆSA LANCEOLATA, *Forsk. Fl. Ægypt.-Arab.* p. cvi.

Near Chirinda, 3500 ft., Northern Melsetter, 5000–6000 ft.; in fl. & fr. April, Sept., Oct.; nn. 142, 172, 669, 6074.

Distrib. North and Tropical Africa, Madagascar, Arabia.

Chindao name, "Ndwatwa." Roots and leaves said to be boiled and the infusion drank for colic and other pains.

N. 669 is the narrow-leaved form of this very variable species; from its general features Mr. Swynnerton thinks this cannot be conspecific with broad-leaved forms.

EMBELIA NYASSANA, *Gilg in Engl. Bot. Jahrb.* xxx. (1901) 96.

Near Chirinda, 3700 ft.; n. 120.

Distrib. Nyasaland.

MYRSINE AFRICANA, *Linn. Sp. Pl.* 196.

Melsetter at 6000 ft.; Mt. Pene, 7000 ft.; Chimanimani Mts. at 7000 ft.; in fl. Sept.; nn. 633, 6153 *a*, 6154 *a*.

Distrib. Azores, Tropical and South Africa, Arabia to China.

RAPANEA UMBRATILIS, *S. Moore*, sp. nov.

Arbuscula ramis superne foliosis inferne ramulorum florigerorum cicatricibus frequenter instructis cortice griseo-brunneo longitrorsum rimoso circumdatis, foliis pro rata parvis oblongo-oblanceolatis obtusissimis raro obtusis basi in petiolum manifestum prima juventute ferrugineum cuneatim angustatis pergamaceis utrinsecus glabris punctis resinosis sparsis indutis, inflorescentiis umbellatis sæpissime 1–3-floris ex ramulis brevissimis ortis, pedicellis incrassatis calyce sæpissimè longioribus juxta basin microscopice ferrugineis, calycis fere omnino glabri segmentis obovatis obtusissimis, corollæ adusque $\frac{2}{3}$ divisæ lobis oblongis obtusis patentibus, antheris sessilibus quam petala paullo brevioribus, stigmate comparate magno cylindrico-pileato.

Hab. Melsetter, in a densely wooded glen at 6000 ft.; in fl. Oct.; n. 6163.

Folia sæpius 3·5–4 cm. long., haud raro 4·5 cm. rarissime 5 cm. attingentia, 1·3–1·8 cm. lat., in sicco grisea; costa media supra impressa subtus optime eminens; costulæ utrinque 8–10, parum aspectabiles; petioli crassi,

circa 5 mm. long., raro paullulum longiores. Ramuli floriferi circa 1·5 mm. long., pedicelli summum 2 mm. Calyx 1·5 mm. long., lobi interdum microscopice ciliolati. Corollæ tubus 1·2 mm., lobi 2·5 mm. long. Antheræ oblongæ, 2 mm. long. Ovarium ovoideo-conicum, 1 mm. long. Stigma fere 1 mm. long., 0·5 mm. lat.

The affinity of this seems to be with *R. ulugurensis*, Mez, of which the flowers are unknown, but its leaves are different from those of the parent plant.

SAPOTACEÆ.

CHRYSOPHYLLUM NATALENSE, *Sond. in Linnæa*, xxiii. (1850) 72.

Chipete Forest Patch ; in fl. Dec. ; n. 21.

Distrib. Pondoland to Mozambique.

Singuni name, " Umhlanchwa "; in Chindao, " Muchanza." The bark yields a milky latex.

C. ARGYROPHYLLUM, *Hiern, Cat. Welw. Pl.* i. 641.

Mt. Maruma, 3700 ft. ; Zona River, Jihu, 2000 ft. ; Chimanimani Mts., at 7000 ft. ; fl. Sept., Nov. ; nn. 22, 22 *a*, 22 *b*.

Distrib. Angola to Rhodesia.

Chindao name, " Muchanza "; Singuni, " Umhlanchwa." Usually a small tree. Fruit said by natives to be excellent eating, and to contain a single white seed. Wood used for making bows.

CHRYSOPHYLLUM (§ Gambeya) FULVUM, *S. Moore*, sp. nov.

Arbor elata ramulis ultimis copiose foliosis teretibus novellis ferrugineis, foliis lanceolato-oblongis vel oblongo-oblanceolatis apice cuspidulato-acuminatis ipso obtusis basi longiuscule cuneatis petiolo quam lamina 8–10-plo breviore coriaceis facie superiore glaberrimis inferiore arcte fulvo- vel ferrugineo-sericeo-tomentosis costis secundariis utrinque solemniter 12–16 intervallis 0·5–0·7 cm. raro 1·0 cm. longis interjectis supra leviter impressis parum perspicuis subtus eminentibus, floribus in axillis glomeratis brevipedicellatis, calycis segmentis ovatis obtusis vel obtusissimis exterioribus coriaceis ferrugineo-tomentellis interioribus membranaceis dilute fulvis tenuiter sericeis necnon margine ciliatis, corollæ calycem paullulum excedentis tubo lobos ovatos vel subrotundatos plane superante, filamentis in dimidio inferiore corollæ tubo adnatis quam antheræ subsagittatæ longioribus, ovario sphærico dense hirsuto quam stylus glaber apice truncatus paullo longiore, fructu sphærico sericeo 4–5-spermo, seminibus ovoideo-oblongis basi attenuatis.

Hab. Chirinda Forest, 3700–4000 ft. ; in fl. & fr. Dec. ; n. 19.

Folia solemniter 8–10 cm. long., ±3 cm. lat. ; costæ secundariæ patentes, juxta marginem arcuatæ ; costulæ arctissime reticulatæ, facie superiore sub lente valde perspicuæ ; petioli ±1 cm. long. Folia ramulorum haud

florigerorum adusque 20 cm. long. et 6 cm. lat., papyracea, subtus albide sericeo-tomentella. Pedicelli incrassati, ferruginei, 1·5 mm. long. Flores albi. Calycis segmenta 3·5 mm. long. Corolla tota 4 mm. long.; tubus 2·5 mm. long.; lobi dense ciliato-barbellati, 1·5 × ± 1·5 mm. Filamentorum pars libera 1·2 mm., antheræ 0·5 mm. long. Ovarium 1·5 mm., stylus 1·2 mm. long. Fructus minute sericei, vix 2·5 cm. diam. Semina 1·8 × 1·0 cm., saturate brunnea, mox pallescentia.

A plant at first sight recalling *C. megalismontana*, Sond., which, on account of the different venation, is placed by Engler in another section of the genus. The nearest affinity is with *C. africanum*, A. DC., but the leaves of *C. fulvum* are smaller, more drawn out at the base, and have a much closer reticulum, the pedicels are distinctly shorter, the corolla larger, the filaments are longer than the anthers, the ovary is larger and differently shaped (this pointing to differences in the fruit), and the style is shorter than the ovary instead of being twice as long.

According to Mr. Swynnerton this is one of the largest trees of the Chirinda Forest, reaching the height of at least 120 feet. He also notes that a milky latex is especially abundant in the fruits. The larger leaves of the barren branches are white below.

MIMUSOPS (§ Quaternaria) SYLVESTRIS, *S. Moore*, sp. nov.

Arbor vel frutex elatus ramulis brevibus superne raro omnimodo foliosis ut novelli ferrugineis cito glabrescentibus, foliis obovato-oblongis obtusis obtusissimisve nonnunquam retusis basi cuneatis pergamaceis glabris costis secundariis utrinque 7–10 teneris pagina inferiore magis perspicuis petiolis limbo 5–7-plo brevioribus glabris fultis, pedicellis in axillis summis maxime approximatis solitariis binisve calycem multo excedentibus ferrugineis, calycis segmentis 8 oblongo-lanceolatis obtusiusculis extus ferrugineis margine griseis, corollæ segmentis 8 oblongo-lanceolatis obtusis quam appendices paullo longioribus, staminibus corollæ segmentis brevioribus antheris lanceolatis obtusiusculis quam filamenta plane brevioribus, staminodiis antheris æquilongis lineari-lanceolatis acuminatis sericeo-pilosis, ovario depresse subgloboso tomentoso, stylo elongato glabro.

Hab. Madanda forests at about 400 ft.; in fl. Dec.; n. 570.

Folia 4·5–7 cm. long., 2–3 cm. lat., plus minus griseo-viridia, supra leviter nitida subtus opaca; costæ secundariæ marginem versus dichotomæ ramis optime arcuatis cum costæ præcedentis sequentisque ramo anastomosantibus; reticulum densum, pagina inferiore difficile aspectabile; petioli circa 5 mm. long., late canaliculati. Pedicelli 1·5–2 cm. long. Calycis segmenta exteriora 7 mm. long., 3 mm. lat., interiora 5·5 × 2 mm., illa intus minute griseo-tomentella, hæc intus glabra. Corollæ segment 7 mm. long., horum appendices vix 6 mm. Filamenta 1·5 mm., antheræ vix 4 mm., staminodia circa 4 mm. long. Ovarium 1·5 × 2 mm.; stylus 6 mm. long.

Allied to *M. marginata*, N. E. Br., which has coriaceous leaves, larger flowers on longer pedicels, and among other features different staminodes.

Chindao name, "Munyewa." Yields a milky latex. Fruits said to be edible.

SIDEROXYLON INERME, *Linn. Sp. Pl.* 192. Var. SCHLECHTERI, *Engl. Monogr. Afr. Sapot.* 27. Beira beach ; in fl. Dec. ; n. 572.

Distrib. (of type) South Africa ; (of var.) Lourenço Marques. Now first announced as a tropical plant.

PACHYSTELA CINEREA, *Pierre ex Engl. l. c.* 36.

Inyamadzi and Chikambogé valleys, 2500–3000 ft.; open woods at Beira ; nn. 571, 571 *a*, 573.

Distrib. West Africa, Nyasaland.

The specimens being without flowers, some doubt must attach to this identification.

EBENACEÆ.

MABA MUALALA, *Welw. ex Hiern, Monogr. Eben.* 111.

Chirinda Forest, 3700–4000 ft. ; in fl. Jan. ; n. 3.

Distrib. Angola.

The flowers of *M. Mualala* being unknown, there is some doubt about this identification ; but the foliage agrees so closely with that of Welwitsch's specimens as to leave no justification for considering Mr. Swynnerton's plant a new species, and in this opinion Mr. Hiern agrees. A description of the flowers is herewith given.

Flores masculi 2–4-ni. Calycis 3-lobi lobi ovato-rotundati, obtusi, limbo subæquales, circa 1 mm. long. Corollæ 4·5 mm. long. lobi obovati, obtusi, 3 mm. long. Stamina 12, calycis tubo affixa ; filamenta circa 1·5 mm. long.; antheræ filamentis æquilongæ, apice puberulæ.

Flores feminei solitarii vel 2-ni. Calycis 3–4-lobi tubus 1·5 mm. long. ; lobi rotundati, obtusissimi, 3–5 mm. long. et lat. Corollæ tubus 2 mm. long. ; lobi 3–4, ovato-oblongi, obtusissimi vel emarginati, 4·5 mm. long. Staminodia 3, clavata, circa 2 mm. long. Ovarium 6-loculare, oblongo-ovoideum, sursum angustatum, 3·5 mm. long. Stylus 1·5 mm. long.

This is one of the tallest trees of the Chirinda Forest. It is called "Black-Bark" by settlers ; Chindao name, "Munyamkungu."

Besides the above, which has milk-white flowers, Mr. Swynnerton collected what appears to be a form or variety of it having yellow flowers. These flowers, besides their colour, differ in the somewhat smaller size of the calyx and corolla and the slightly larger stamens. This also was found in the Chirinda Forest (n. 2), and passes under the same popular name as the type.

MABA NATALENSIS, *Harv. Thes. Cap.* ii. 7, t. 110.
Madanda forests at about 400 ft.; in fl. Dec.; n. 1738.
Distrib. Eastern South Africa; recently reported from Mozambique.

ROYENA PALLENS, *Thunb. Prod. Fl. Cap.* 80.
Near Chirinda, 3800 ft.; Mt. Pene, 7000 ft.; fl. Oct.; nn. 62, 6070.
Distrib. South Africa and northwards to Angola and Nyasaland.

EUCLEA LANCEOLATA, *E. Mey. in Drège, Zwei Pflanz. Doc.* 184.
Near Chirinda, 3500 ft.; Chipete Forest Patch; Umvumvumvu River at 2000 ft.; Mt. Umtereni, 4000 ft.; in fl. April, Sept.; nn. 743, 1298, 1305, 1306.
Distrib. Rhodesia to Angola, South Africa.

E. NATALENSIS, *A. DC. in DC. Prod.* viii. 218.
Beira beach; in fl. Dec.; n. 1181.
Distrib. Natal.

DIOSPYROS MESPILIFORMIS, *Hochst. ex A. DC. in DC. Prod.* viii. 672.
South Umtali district at 2000–3000 ft.; Umvumvumvu River at 4000 ft.; in fr. Oct., in fl. Dec.; nn. 6071, 6622.
Distrib. Tropical Africa.

D. SENENSIS, *Klotzsch in Peters Mossamb. Bot.* 183.
On limestone, Boka, Lower Buzi, 100 ft.; in fl. Dec.; n. 2024.
Distrib. Mozambique, Nigeria.

D. SHIRENSIS, *Hiern in Journ. Bot.* xxxiii. (1895) 179.
Lower Umswirizwi River, 1000 ft.; Chibabava, Lower Buzi, 400 ft.; Madanda forests at about 400 ft.; Boka, Lower Buzi; in fl. Nov., Dec.; nn. 2024 *a*, 2025, 2026, 2027, 2028, 2029.
Distrib. Nyasaland.

D. LOUREIRIANA, *G. Don, Gen. Syst.* iv. 39.
Chibabava, Lower Buzi, 400 ft.; Madanda forests; Zinqumbo hills, 1500 ft.; in fl. Nov., Dec.; nn. 1189, 1190, 1190 *a*, 1194.
Distrib. Mozambique to Angola.

DIOSPYROS SABIENSIS, *Hiern*, sp. nov.
Arbor dioica satis ramulosa ut videtur sempervirens, ramulis alternis tenuibus patenti-erectis mox glabris, internodiis superioribus quam folia brevioribus, foliis alternis ovali-oblongis apice obtusis basi rotundis vel obtuse contractis patulis papyraceo-coriariis supra lucidis subter paulum pallidioribus primum puberulis subinde costa excepta glabratis integerrimis planis vel vix margine undulatis 2·5–9 cm. longis 1–2·7 cm. latis nervis et reticulo simul infirmis, petiolo puberulo firmo 3–6 mm. longo; cymis masculis trichotomis

crebris vix] laxiusculis pubescentibus vel puberulis axillaribus quam folia brevioribus, pedicellis ultimis brevibus, bracteolis linearibus parvis dorso puberulis, floribus masculis numerosis tetrameris extra dense pubescentibus 5–6 mm. longis, calyce campanulato-hemispherico utrinque pubescente 4·5 mm. longo lobis deltoideo-ovatis 2·5 mm. longis, corolla breviter lobata crassiuscula extra basi excepta pubescente intus glabra lobis ovatis obtusis concavis patulis 1·5 mm. longis in æstivatione sinistrorse (deorsum visis) contortis tubo campanulato 3–4 mm. longo, staminibus 11–12 glabris receptaculo vel paucis basi corollæ insertis 2–2·5 mm. longis antheris lanceolato-linearibus obtusis 2 mm. longis filamentis gracilibus 0–0·5 mm. longis, ovario minimo rudimentario pubescenti-hispido.

Hab. Sabi River, at about 1000 ft.; in fl. Nov.; n. 1209.

Chindao name, "Mushuma."

OLEACEÆ.

JASMINUM STENOLOBUM, *Rolfe in Oates, Matabel.* ed. 2, 403.

Sabi River at about 1000 ft.; in fl. Nov.; n. 2034.

Distrib. Rhodesia. The Nyasaland plant usually referred here seems to me to be different.

JASMINUM SWYNNERTONII, *S. Moore*, sp. nov.

Ramulis gracilibus scandentibus foliosis pubescentibus, foliis oppositis raro suboppositis simplicibus brevipetiolatis ovatis vel ovato-lanceolatis apicem versus attenuatis apice apiculatis basi plus minus rotundatis membranaceis supra obscure puberulis subtus in nervis pubescentibus, floribus terminalibus 2–3-nis pedicellis pubescentibus quam calyces longioribus insidentibus, bracteis parvulis subulatis a pedicellis magnopere superatis, calycis subhemisphærici puberuli lobis limbo duplo longioribus lineari-subulatis acutis, corollæ glabræ tubo calycem 8–10-plo excedente lobis 7 (an semper?) quam tubus paullulum brevioribus anguste oblongis acutis, antherarum connectivo mucronato, stylo breviter exserto claviformi apice biramoso, ovulis in loculis solitariis.

Hab. Kurumadzi River, Jihu, and near Spungabera; n. 180, 180 *a*.

Folia 2·5–5 cm. long., 1·2–2·3 cm. lat.; costæ secundariæ utrinque 3–5; petioli 2–3 mm. long., pubescentes. Cymæ (floribus inclusis) adusque 3·5 cm. long. Pedicelli 7–9 mm. long., graciles. Bracteæ 2 mm. long. Flores albi. Calycis limbus 2–2·5 mm. long.; lobi 4 mm. Alabastra acuminata. Corollæ tubus 2 cm. long., inferne 1·5 mm., faucibus 2·5 mm. diam.; lobi 1·9 cm. long. Filamenta ægre 5 mm. long. Stylus 1·2 cm. long., apice 1 mm. lat.; rami late subulati, acuti, vix 2 mm. long.

Nearest *J. tomentosum*, Knobl., from which its chief differences are the ternate long-pedicelled flowers, the shorter and broader calyx-lobes, and the corollas with lobes nearly twice as long.

JASMINUM MAURITIANUM, *Bojer, Hort. Maur.* 204.

Bank of Umswirizwi River, 1000 ft.; Chibabava, Lower Buzi, 400 ft.; Sabi River at about 1000 ft.; fl. Nov.; nn. 206, 206 *a*, 2033.

Distrib. Tropical Africa, Mascarene Islands.

DEKINDTIA AFRICANA, *Gilg in Engl. Bot. Jahrb.* xxxii. (1902) 139.

Kloof near Chirinda, 3800 ft.; in fl. Oct.; n. 171.

Distrib. Nyasaland, Angola. A medium-sized tree.

OLEA WOODIANA, *Knobl. in Engl. Bot. Jahrb.* xvii. (1893) 532.

Chimanimani Mts. at 7000 ft.; in bud Sept.; n. 1281.

Distrib. Natal.

Though the flowers are not mature, I have little doubt about this identification. A species not previously recorded from the tropics.

APOCYNEÆ.

LANDOLPHIA (§ Jasminochyla) SWYNNERTONII, *S. Moore*, sp. nov.

Frutex scandens cirris sat validis raris ex furcis ramulorum ortis onustus, ramulis ultimis patentibus teretibus pubescentibus deinde glabrescentibus, foliis brevipetiolatis oblongo-lanceolatis apicem versus sæpe cuspidato-attenuatis apice ipso obtusis basi plus minus rotundatis pergamaceis costa media facie inferiore prominula sæpe piloso-puberula exempta glabris in sicco viridibus vel griseo-olivaceis costis secundariis utrinque 12–15 parum aspectabilibus patentibus rectis vel fere rectis juxta marginem subito arcuatis, corymbis abbreviatis sc. a foliis longe superatis pedunculis brevibus fultis paucifloris pubescentibus, bracteis quam pedicelli brevioribus ovato-oblongis lanceolatisve pubescentibus, calycis pubescentis puberulisve lobis ovatis obtusis margine tenuibus necnon ciliolatis, corollæ glabræ vel fere glabræ tubo paullulum infra medium dilatato quam lobi oblongi obtusi paullo breviore, staminibus infra medium tubum insertis antheris lanceolatis obtusiusculis, ovario ovoideo-oblongo glabro stylo abbreviato longiore, bacca sphæroidea albo-maculata eduli.

Hab. Chirinda Forest, 3700–4000 ft.; in fl. Nov.; n. 82.

Cirri unici mera basis mihi obvia. Foliorum limbus solemniter 5–7 cm. long., 1·8–2·5 cm. lat., facie inferiore sæpe pallidior; costa media supra excavata; costulæ supra planæ subtus leviter prominulæ; petioli late canaliculati, pubescentes, circa 3 mm. long. Flores pro corymbo sæpissime 6–8. Pedunculi ± 5 mm. long., rarius adusque 1·5 cm. Bracteæ circa 1·5 mm., pedicelli 2 mm. long. Flores albi, odorem *Jasmini officinalis* spirantes. Calyx 2·5 mm. long. Corollæ tubus 7 mm. long., basi 1·5 mm. lat., paullo supra basin adusque 2·5 mm. dilatatus, superne 2 mm. lat.; lobi 8 × 2·2 mm. Antheræ ad 2·75 mm. supra basin tubi insertæ, 1·75 mm. long. Ovarium

1·25 mm. × 1 mm. ; stylus vix 1 mm. long. ; stigma bifidum. Bacca juvenilis fere 2·5 cm. diam.

To be inserted next *L. Cameronis*, Stapf ; the chief points of difference being its pubescent inflorescences, shorter corolla-tube with shorter and narrower lobes, the shorter and narrower anthers inserted lower down upon the corolla-tube, and the short style.

"A large woody climber yielding a milky latex and excellent rubber, scantier than in *L. Kirkii*. Bark smooth, light grey. Stems deeply fluted. Young shoots pink. Flowers white, strongly jessamine-scented ; petals tinged below with light reddish-brown. Fruit spherical, large, edible and making an excellent conserve. Chindao names, 'Munugu' or 'Mubungu.'"

LANDOLPHIA FLORIDA, *Benth. in Hook. Niger Fl.* 444.

Umswirizwi River, Lower Buzi, 500 ft. ; in fl. Nov. ; n. 1081.

Distrib. Tropical Africa, also Madagascar and Comoro Islands.

Chindao name, "Mukonja" ; Singuni name, "Umkonza." A very large woody climber, one that was measured being 5 ft. 6 in. in circumference at 3 ft. from the base.

L. KIRKII, *Dyer in Kew Gard. Rep.* 1880, 39.

Madanda forests at about 400 ft. ; kloof near Chirinda, 3800 ft. ; in fl. Oct.–Dec. ; nn. 81, 81 *a*. Chindao name, "Mubungu."

Distrib. Tropical East Africa.

L. LUCIDA, *K. Schum. in Notizbl. K. Bot. Gart. Berlin*, i. (1895) 24.

Chirinda Forest, 3700 ft. ; Spungabera forest patch, 3500 ft. ; fl. Feb., young fr. April ; nn. 83, 83 *a*.

Distrib. Congo Free State, Cameroons.

This identification is somewhat doubtful as I have not seen the flowers of the type : the leaves of both specimens are smaller than those of an unsatisfactory specimen without flowers from the Cameroons (*Zenker*, 2459 *a*) in the British Museum.

Chindao name, "Chiwhongororo." A very large woody climber, reaching the tops of the trees. Milky latex apparently destitute of rubber. Fruit smooth, sweetish, bright orange, eaten by natives.

CARISSA EDULIS, *Vahl, Symb.* i. 22. Var. TOMENTOSA, *Stapf, in Fl. Trop. Afr.* iv. i. 90.

Near Chirinda, 3800 ft. ; South Umtali District, 2000–3000 ft. ; fl. Oct., Nov., Dec. ; nn. 70, 6621, 6623.

Distrib. Tropical Africa.

CARISSA ARDUINA, *Lam. Encycl.* i. 555.

Chirinda Forest 3700–4000 ft.; Chikambogé Valley 3000 ft.; Mt. Pene 7000 ft.; Umhlonho, Lower Buzi 100 ft.; open woods at Beira; in fl. Sept., Oct., Dec., in fr. Oct.

Distrib. Nyasaland, Rhodesia, South Africa.

Chindao name, "Murowa-ngombe"; Singuni, "Umblab' inkunzi."

PLEIOCARPA SWYNNERTONII, *S. Moore*, sp. nov.

Arbor elata, glaber, foliis oppositis rarius ternatis lanceolatis vel oblanceolatis vel lanceolato-oblongis apice obtusis sæpe breviter cuspidatis in petiolum crassiusculum desinentibus tenuiter coriaceis costis secundariis pluribus (utrinque ultra 20) facie superiore nitente valde perspicuis, cymis axillaribus raro pseudoterminalibus solitariis oppositisve sessilibus paucifloris, calycis crassiusculi lobis suborbicularibus tubum excedentibus, corollæ tubo calycem 4-plo excedente sursum levissime amplificato quam lobi obovati obtusissimi haud duplo longiore, staminibus paullo infra fauces insertis antheris ovato-oblongis, carpellis 2 oblongo-ovoideis glabris, ovulis quoque in loculo 4, baccis 1- (nonnunquam 2–3-) spermis.

Hab. Chirinda Forest; in fl. Sept., in fr. Dec.; nn. 14, 6503.

Foliorum lamina 8–11 cm. long., 3–5 cm. lat., in sicco viridis vel viridigrisea, pagina inferiore pallidior; costa media subtus valde prominens; petioli late excavati, 1–2 cm. long. Cymæ pansæ circa 1·5 cm. diam. Flores albi. Calyx 2·2 mm. long.; tubus 0·7 mm., lobi 1·5 mm. long. Corollæ tubus intus pilosus, 8 mm. long., juxta medium 1·5 mm., faucibus 2 mm. lat.; lobi 5 mm. long. Filamenta 0·5 mm., antheræ 1·2 long. connectivo excurrente haud exempto. Carpella 1 mm. long. Stylus glaber, ægre 1 cm. long.; stigma 7·5 mm. long. Baccæ ovoideæ, in sicco rugosæ, circa 1·5 cm. long.; semina compressa, 12 × 7 mm.

Very like *P. Bagshawei*, S. Moore, and to be inserted next it in the genus. The tree-like habit, the at most ternate leaves, the broad lobes of the calyx, the shorter corolla-tube, and the 4-ovuled carpels are the chief distinguishing features of the new species.

Mr. Swynnerton informs me that this tree sometimes reaches a height of 80 feet, with the trunk more than 2 feet wide at its base. In a recent letter he says that the berries are glossy green outside with firm white flesh, while the seeds, usually single, but sometimes two or even three to each berry, are salmon-pink and have the appearance of a haricot-bean.

DIPLORHYNCHUS MOSSAMBICENSIS, *Benth. in Hook. Ic. Pl.* t. 1355.

Chibabava, Lower Buzi 400 ft.; Umswirizwi flats 1100 ft.; Inyamadzi Valley 2500 ft.; Chikore Hills 3500 ft. (fruit only); in fl. Nov., Dec.; fr. April, Sept.; nn. 39, 39 *a*, 2101.

Distrib. East, Central, and South tropical Africa.

Chindao name, "Mutowa." A small to medium-sized tree, 30 ft. high. Yields a white milky latex, which is smeared over broken fingers spliced with bark-fibre, and is used to fix arrow-heads in their sockets.

RAUWOLFIA INEBRIANS, *K. Schum. in Engl. Pflanzenw. Ost-Afr.* C. 318.

Chirinda Forest, 3700–4000 ft.; Kurumadzi River, 2000 ft.; Inyamadzi Valley, 3000 ft.; in fl. Sept.–Nov.; nn. 6, 6 *a*, 602.

Distrib. German East Africa.

Singuni name, "Umkadhlwa." "A handsome tree, 80 feet high. Bark ochreous yellow and somewhat rough, that of the thinner branches yielding a milky latex. Timber yellowish white and very easily worked: it has been tried lately by one or two settlers in house-building and found useful for windows and doors. Termites and *Bostrychidæ* do not attack it. Thousands of seedlings spring up with the late rain, but those exposed to the sun on the outskirts of the forest usually die off during the ensuing dry season. Owing to its rapid and symmetrical growth and the beauty of its foliage, it is being planted by settlers as a shade tree."

CALLICHILIA ORIENTALIS, *S. Moore*, sp. nov.

Fruticosa, glabra, ramulis ascendentibus gracilibus sursum foliosis cortice sordide albo longitrorsum rimoso lenticellifero mox circumdatis, foliis pro rata parvis lanceolatis lanceolato-oblongisve superne gradatim extenuatis apice obtusis basi in petiolum manifestum breviter angustatis margine leviter undulatis papyraceis costis secundariis utrinque 7–9, floribus pro rata parvis in cymas terminales racemiformes pedunculatas paucifloras a foliis sæpius superatas dispositis, bracteis parvis quam pedicelli pluries brevioribus, calycis campanulati exigui segmentis inter se inæqualibus late oblongis obtusissimis, corollæ comparate parvæ calycem fere triplo excedente tubo inferne angusto paullo infra apicem cylindrico-dilatato intus fere glabro lobis suborbicularibus tubo plane brevioribus, staminibus 5 mm. infra os corollæ tubo insertis.

Hab. Boka, Lower Buzi River, on limestone in a wooded glen; in fl. Dec.; n. 1148.

Folia vulgo 4·5–9 cm. long., 2–2·7 cm. lat., in sicco utrobique (subtus dilutius) viridia; costa media supra impressa, subtus optime prominens; ordinis secundi costæ teneræ; supra planæ, subtus eminentes; reticulum laxum; petiolus canaliculatus, circa 5 mm. long. Stipulæ subulatæ, 2 mm. long. Pedunculus ±10 mm. long., pedicelli 7–20 mm., bracteæ circa 2 mm. Calycis segmenta 4–7 mm. long., 3–4 mm. lat., intus basi glandulis parvulis numerosis instructa. Corollæ tubus 17 mm. long., deorsum 1·5 mm. sursum 3 mm. lat.; lobi 10 mm. long. Antheræ 3 mm. long. Carpella 1·5 mm., stylus 2·5 mm. long.

The species of *Callichilia* hitherto known are large-leaved West-African shrubs with flowers bigger than those of their new congener. Nevertheless the inclusion of this plant in the genus seems advisable, at least for the

present, and Dr. Stapf, who was good enough to look at the specimens, confirms me in this view. At the same time it may possibly prove the type of a new genus when its fruits come to hand.

CONOPHARYNGIA STAPFIANA, *Stapf in Fl. Trop. Afr.* iv. i. 147.

Mt. Pene, 7000 ft.; in fl. Oct.; n. 6148.

Distrib. Nyasaland.

N. 560 from the same locality, said to bear fruits 5 inches in diameter, should probably be referred here. There are no flowers.

C. ELEGANS, *Stapf in Fl. Trop. Afr.* iv. i. 149.

Jihu, 2300 ft.; Zona-Kurumadzi watershed, Kurumadzi River, 2000 ft.; in fl. Nov.; nn. 38, 2035.

Distrib. East tropical Africa.

Chindao name, "Ruchene." A shrub up to 20 feet high, and 6 or 8 inches in diameter of trunk. The abundant milky latex is regarded as a powerful remedy for the vomiting of milk by infants, being placed in a hollow reed and hung round the neck as a charm.

C. USAMBARENSIS, *Stapf in Fl. Trop. Afr.* iv. i. 148.

Chirinda Forest, 3700–4000 ft.; in fl. and young fr. Oct.; nn. 37, 37 *a*.

Distrib. East tropical Africa.

Chindao name, "Ruchene." A shrubby tree reaching 25 ft., with diameter of trunk 8 in. Yields somewhat abundant milky latex, but apparently no rubber.

VOACANGA LUTESCENS, *Stapf in Fl. Trop. Afr.* iv. i. 157.

Chibabava and Umhlohlo, Lower Buzi; in fl. Nov., fr. Jan.; n. 559.

Distrib. East tropical Africa.

A small tree 25 feet high, with scanty latex and white flowers. Chindao name, "Ruchene." The bast is said to be used for cord.

HOLARRHENA FEBRIFUGA, *Klotzsch in Peters Mossamb. Bot.* 277.

Sitatonga Range, Middle Buzi; near Chibabava, Lower Buzi, 400 ft.; Mount Singuno at 1500 ft.; in fl. & fr. Nov., Dec.; nn. 209, 209 *a*, 209 *b*.

Distrib. Nyasaland, Zambesia.

MASCARENHASIA VARIEGATA, *Britt. & Rendle in Trans. Linn. Soc., Bot.* ser. 2, iv. (1894) 26.

Beira, in open woods about 6 miles up the railway; in fl. Dec.; n. 558.

Distrib. Nyasaland.

Follicles in the dry state greyish-brown, longitudinally striated, about 8 cm. long, and when opened 2 cm. across, with a polished inner surface; the linear brown seeds are 1 cm. long and are crowned by a rich brown coma nearly $2\frac{1}{2}$ times their length.

Alafia Swynnertonii, *S. Moore*, sp. nov.

Sarmentosa, ramis frequenter ramulosis ramulis ultimis brevibus foliosis, foliis breviter petiolatis oblongo-ovatis sæpissime cuspidulatis apice obtusis basi cuneatis raro subrotundatis pergamaceis glabris costis secundariis utrinque numerosis, floribus majusculis in pseudoumbellas terminales subsessiles pauci-floras dispositis, pedicellis gracilibus calyces longe excedentibus, calycis segmentis lanceolato-oblongis obtusis glabris, corollæ tubo calycem triplo excedente extus glabro intus juxta staminum insertionem pubescente lobis oblongo-obovatis obtusis tubum facile excedentibus extus puberulis, antherarum cono incluso.

Hab. Madanda forests at about 400 ft. ; in fl. Dec. ; n. 1178.

Foliorum limbus vulgo 5–6·5 cm. long., 2·3–3 cm. lat., in sicco pallide nitidus, griseo- vel brunneo-viridis ; costæ secundariæ utrinque circa 10–12 (interjectis aliis ordinis tertii paullo minus perspicuis), supra planæ leviterve impressæ, subtus eminentes ; reticulum laxum ; petioli 2–4 mm. long. Pedunculi 1–2 mm. long., pedicelli summum 8 mm. sed sæpius breviores. Calyx totus vix 2 mm. long. ; hujus lobi 1·25 mm. Corollæ tubus ægre 6 mm. long., prope medium 3·5 mm. ore 2 mm. lat. ; lobi 11 mm. long., summum 4 mm. lat. Antheræ 3 mm. long., dorso pubescentes. Ovarium puberulum, vix 2 mm. long.

To be inserted next *A. microstylis*, K. Schum., a plant imperfectly known in this country till recently and, as a specimen now in the Kew Herbarium shows, identical with my subsequently described *A. clusioides.* The chief points of distinction about *A. Swynnertonii* are the shape and consistence of the leaves and the subsessile inflorescences.

Oncinotis chirindica, *S. Moore*, sp. nov.

Scandens ramulis teretibus glabrescentibus juvenilibus gracilibus necnon minute pubescentibus, foliis breviter petiolatis lanceolato-oblongis vel oblongo-oblanceolatis cuspidatis vel breviter acuminatis basi obtusis tenuiter coriaceis supra glabris subtus minutissime furfuraceis costis secundariis utrinque 4 ad-scendenti-arcuatis facie superiore leviter impressis inf. eminentibus, paniculis axillaribus gracilibus laxis plurifloris foliis fere æquilongis minute ferrugineis, pedicellis calycem plerumque paullo excedentibus, calycis eglandulosi lobis oblongo-lanceolatis obtusis minute ferrugineis, corollæ tubo calycem excedente extus minutissime ferrugineo lobis tubo longioribus linearibus acutis, disco 5-partito.

Hab. Chirinda Forest, 3700–4000 ft. ; in fl. & fr. Oct. ; n. 87.

Foliorum limbus 7–10 cm. long., 2·5–3·5 cm. lat., in sicco plerumque brunneo-olivaceus ; petioli 5–10 mm. long., supra late canaliculati, minute puberuli. Paniculæ 4·5–9 cm. long., hujus rami tenues, apertissimi ; bracteæ lineari-subulatæ, caducæ, $\pm$ 2 mm. long. Flores virides. Pedicelli profecto evoluti solemniter 4–5 mm. long., graciles, minute ferruginei. Calycis pars

indivisa circa 0·75 mm. long.; lobi ægre 3 mm. Corollæ tubus adusque 4·5 mm. long., juxta medium 2·25 mm. diam.; squamæ 0·4 mm., lobi 6 mm. long. Antheræ 2 mm. long. Disci lobi quadrati, 0·75 mm. long. Ovarii carpella 1·25 mm. long. Folliculus 12·5–15 cm. long., summum fere 1 cm. diam., minutissime tomentella. Semina anguste oblongo-linearia, sursum attenuata, 1·4 cm. long.; coma circa 3·5 cm. long.

Differs from *O. inandensis*, Wood & Evans, which it much resembles, chiefly in the longer pedicels, the larger calyx with longer and relatively narrower lobes, and the larger longer-lobed corollas.

A large woody vine with very rough and thick yellow bark, and a milky latex. Sometimes near the base it is 15 or 18 inches in diameter.

ADENIUM MULTIFLORUM, *Klotzsch in Peters Mossamb. Bot.* 279.
Sabi River at about 1000 ft.; in fr. Nov.; n. 557.
Distrib. Nyasaland, Zambesia.

ASCLEPIADEÆ.

CRYPTOLEPIS OBLONGIFOLIA, *Schlechter in Journ. Bot.* xxxiv. (1896) 315.
In grass near Chirinda; in fl. & fr. Oct.; n. 243.
Distrib. Uganda, Mozambique.
Yields milky latex and good fibre.

SECAMONE ALPINI, *Schult. in Rœm. & Schult. Syst. Veg.* vi. 125.
Outskirts of Chirinda, 3700–4000 ft.; in fl. Dec.; n. 88.
Distrib. Nyasaland.

S. ZAMBESIACA, *Schlechter in Journ. Bot.* xxxiii. (1895) 303.
Umhlonho, Lower Buzi; Madanda forests; in fl. Dec.; nn. 1921, 1921 *a*.
Distrib. Nyasaland.

XYSMALOBIUM RETICULATUM, *N. E. Br. in Kew Bull.* 1895, 251.
Near Chirinda, 3800 ft.; Lower Umswirizwi River, 1000 ft.; in fl. Oct., Nov.; nn. 247, 247 A.
Distrib. Uganda to Rhodesia.

ASCLEPIAS SWYNNERTONII, *S. Moore*, sp. nov.

Verisimiliter circa spithamea caule erecto omnimodo folioso crassiusculo bifariatim piloso hispidulove, foliis satis approximatis brevipetiolatis ovato-oblongis obtusis vel obtuse acutis basi rotundatis leviterve cordatis margine obscure revolutis utrinque fere omnino glabris margine microscopice serrulato-ciliatis membranaceis, umbellis ex axillis foliorum superiorum ortis corymbosis, pedunculis piloso-pubescentibus inferioribus quam superiores longioribus et

foliis brevioribus, bracteis anguste linearibus quam pedicelli pilosi manifeste brevioribus, calycis puberuli segmentis lanceolato-oblongis obtusiusculis, corollæ rotatæ lobis late ovato-oblongis obtusis demum reflexis, coronæ phyllis paullulum ex columnæ stamineæ basi enatis ipsi columnæ æquialtis inferne leviter cucullatis superne complicatis dorso carinatis intus inappendiculatis glabrisque lobis lateralibus brevibus triangularibus acutis lobum centralem truncatum haud superantibus, antherarum appendicibus sursum inflexis.

Hab. Mt. Pene, 7000 ft.; Melsetter at 6000 ft.; in fl. Oct.; nn. 6092, 6093.

Folia vulgo 4–4·5×2·2–2·8 cm., subglauca; petioli 2–3 mm. long. Pedunculi summum 2·5 cm. long. Bracteæ circa 6 mm., pedicelli solemniter 1–2 cm. long. Flores luteo-virides. Calycis segmenta 5 mm. long. Corollæ lobi 7 mm. long. Coronæ phylla ægre 3 mm. long., sub apice 2·5 mm. lat.; lobi laterales circa 0·8 mm. long. Antherarum appendices ovati, 1 mm. long. Pollinia oblongo-pyriformia, 1·2 mm. long.; glandula 0·25 mm., caudicula 0·1 mm. long.

In general appearance this reminds one somewhat of *A. glaucophylla*, Schlechter, but the stalked leaves are not so large and the flowers much smaller and otherwise different. The position in the genus is next *A. modesta*, N. E. Br.

ASCLEPIAS FULVA, *N. E. Br. in Kew Bull.* 1895, 254.
Near Chirinda, 3600 ft.; in fl. Jan.; n. 1914.
Distrib. Uganda, German East Africa.

A. LINEOLATA, *Schlechter in Journ. Bot.* xxxiii. (1895) 336.
Hills north of the Upper Buzi, 3200 ft.; Lower Umswirizwi River, 1000 ft.; in fl. Nov., Dec.; nn. 245, 1920.
Distrib. Tropical Africa.

A. COARTATA, *S. Moore in Journ. Bot.* xlvi. (1908) 297.
Chibabava, Lower Buzi, 400 ft.; Lower Umswirizwi River, 1000 ft.; in fl. Nov., Dec.; nn. 248, 1895.
Distrib. Endemic.

A. SCABRIFOLIA, *S. Moore, l. c.*
Mt. Pene, 7000 ft.; Chimanimani Mts. at 7000 ft.; in fl. Sept., Oct.; nn. 1915, 6094, 6140.
Distrib. Endemic.

A. REFLEXA, *Britt. & Rendle in Trans. Linn. Soc., Bot.* ser. 2, iv. (1894) 28.
Open woods at Beira; fl. Dec.; n. 1918.
Distrib. Tropical East Africa.

SCHIZOGLOSSUM CHIRINDENSE, *S. Moore in Journ. Bot.* xlvi. (1908) 295.
Near Chirinda, 3800 ft.; Mt. Pene, 7000 ft.; in fl. Sept., Oct.; nn. 246, 6095.
Distrib. Endemic.

MARGARETTA WHYTEI, *K. Schum. in Engl. Pflanzenw. Ost-Afr.* C. 323.
Near Chirinda, 3800 ft.; Lower Umswirizwi River; in fl. Oct., Nov.; nn. 1912, 1913.
Distrib. Nyasaland, Zambesia, Rhodesia.

CYNANCHUM CHIRINDENSE, *S. Moore in Journ. Bot.* xlvi. (1908) 305.
Chirinda Forest, 3900 ft.; in fl. Feb.; n. 137.
Distrib. Endemic.

MARSDENIA ZAMBESIACA, *Schlechter in Journ. Bot.* xxxiii. (1895) 338.
Boka, Lower Buzi; in fl. Dec.; n. 1917.
Distrib. Angola to Zambesia.

M. GAZENSIS, *S. Moore in Journ. Bot.* xlvi. (1908) 306.
Kurumadzi River, Jihu; in fl. Jan.; n. 224.
Distrib. Endemic.

SWYNNERTONIA CARDINEA, *S. Moore, l. c.* 308, t. 495.
Chirinda Forest, 3700–4000 ft.; in fl. Oct., Dec.; nn. 1080, 6518.
Distrib. Endemic.

After the publication of this interesting plant, Mr. Swynnerton sent me a number of notes made with the living object before him, notes which show one or two inaccuracies in the original description and figure. The chief of these relates to the inner corona, which I described as adnate to the staminal column without noticing, or directing Mr. Highley's attention to, the fact of each of the inner coronal leaves being produced at the base into a short spur free from the column, just as is the case with *Dœmia.* In fig. 4 of Plate **5,** a copy of one of Mr. Swynnerton's sketches, the structure of the corona is well shown. The diagnosis of the corona, therefore, needs a slight alteration and should read thus :—

"Corona duplex ex apice columnæ stamineæ orta; phylla exteriora 5, corollæ lobis opposita, comparate parva, phylla interiora quam exteriora longiora, columnæ stamineæ impendentia, quodque more *Dœmiarum* basi in calcare libero brevi productum."

An examination of the figure will show that the outer coronal leaves are not emarginate as before described, such emargination being the effect of drying under pressure. The hairiness of these organs should also be noticed; this has been omitted from the figures previously published, and indeed is difficult to see in the dried state except when the flower has been very well pressed.

In habit, it may be added, *Swynnertonia* is much like Schlechter's recently described *Neoschumannia* from West Africa. Schlechter refers this to the Ceropegiinæ, his drawing (Engler, Bot. Jahrb. xxxviii. (1895) p. 39, fig. 4) showing pollinia with at most but a faint trace of caudicles. But any suspicion that Schlechter's plant and the one under notice might be congeneric is dispelled by the fact of the former's corona being triple, with an outer series of long reflexed lobes, which series is unrepresented in *Swynnertonia*.

CEROPEGIA HISPIDIPES, *S. Moore in Journ. Bot.* xlvi. (1908) 309.
Near Chirinda, 3800 ft.; in fl. Feb.; n. 1137.
Distrib. Endemic.

RIOCREUXIA PROFUSA, *N. E. Br. in Kew Bull.* 1895, 260.
Chikore Hills, 3500 ft.; in fl. April; n. 205.
Distrib. Nyasaland.

LOGANIACEÆ.

MOSTUEA WALLERI, *Bak. in Kew Bull.* 1895, 96.
Chirinda Forest at 3800 ft.; in fl. Dec.; n. 6511.
Distrib. Zambesia.

BUDDLEIA SALVIFOLIA, *Lam. Encycl.* i. 513.
Melsetter, 6000 ft.; Mt. Pene at 6500–7000 ft.; in fl. Sept., Oct.; nn. 609, 675, 6090.
Distrib. A South-African plant extending to Nyasaland and Angola.

NUXIA SAMBESINA, *Gilg in Engl. Pflanzenw. Ost-Afr.* C. 312.
Melsetter, 6000 ft.; in fl. Sept.; n. 606.
Distrib. Nyasaland.

N. HOLSTII, *Gilg in Engl. Pflanzenw. Ost-Afr.* C. 312.
Melsetter; in fl. April; n. 1902.
Distrib. Usambara, Nyasaland.

N. DENTATA, *R. Br. in Salt Abyss., App.* 63.
Lower Umswirizwi River, 100 ft.; Lusitu River at 3000 ft.; in fl. Sept., Nov.; nn. 1179, 1294.
Distrib. From Arabia and Abyssinia to East Africa and Angola; also in Eastern South Africa.

STRYCHNOS FLORIBUNDA, *Gilg in Engl. Bot. Jahrb.* xvii. (1893) 566.
Madanda forests at about 400 ft.; in fl. Dec.; nn. 1071, 1073.
Distrib. Congo Free State.
A large shrub with white flowers and gamboge-yellow fruit.

STRYCHNOS (§ Intermediæ) MICANS, *S. Moore*, sp. nov.

Frutex erectus vel arbor parva ramulis gracillimis teretibus ad nodos tumidis cortice cinereo vel fusco obductis, foliis pro rata parvis petiolatis lanceolatis vel lanceolato-ovatis longiuscule cuspidato-acuminatis basi obtusis tenuiter coriaceis glabris supra nitidis in sicco olivaceis subtus olivaceo-viridibus 5-nervibus jugo proximali debili fere a basi frequentissime arcuato-anfractuoso apicem fere attingente jugo distali ad 2–4 mm. a basi costæ centrali inserto quam jugum proximale validiore etsi tenui, cymis brevibus axillaribus laxis paucifloris, bracteis parvis subulatis acutis rigidis, floribus pedicellatis 4-meris, calycis minuti lobis ovatis obtusis vel obtusiusculis microscopice ciliolatis, corollæ tubo calyci æquilongo late cylindrico faucibus albo-villosis lobis tubum excedentibus oblongis obtusis dorso minute fulvo-pubescentibus, filamentis complanatis antheris ovatis æquilongis, ovario oblongo-ovoideo in stylum paulo longiorem attenuato.

Hab. Chirinda Forest, 3700–4000 ft.; in fl. Dec.; n. 125.

Ramuli nudo 1–1·5 mm. diam. Folia solemniter 4–5×1·7–2 cm.; petioli 5 mm. long., transversim rugulosi. Cymæ usque ad 8 mm. long., circa 6 mm. diam. Pedunculus 2–3 mm. long.; pedicelli vulgo circa 2 mm. long. Bracteæ 1–2 mm. long. Calyx ægre 1 mm. long. Corollæ tubus 1·2 mm. long., 1·5 mm. lat.; lobi vix 2 mm. long. Filamenta necnon antheræ 0·6 mm. long. Ovarium 1 mm., stylus 1·25 mm. long.

In appearance this somewhat resembles *S. Welwitschii*, Gilg, one of the climbing species. The affinity seems to be with *S. Marquesii*, Bak., and *S. pungens*, Soler., but from both it differs in leaf as well as flower.

STRYCHNOS (§ Intermediæ) MITIS, *S. Moore*, sp. nov.

Arbor excelsa cortice badio levi obducta, ramulis teretibus ad nodos tumidis crebro foliosis cinereis, foliis oblanceolato-oblongis nunc obtusis nunc acutiusculis vel cuspidato-acuminatis basi in petiolum brevem angustatis sub anthesi tenuiter sub fructescentia rigide coriaceis supra nitentibus subtus pallidioribus necnon opacis glabris 5-nervibus jugo proximali tenui ad apicem usque fere perveniente jugo distali a basi satis remoto jugarum costis sæpe costæ centrali alternatim affixis, cymis axillaribus pedunculo communi perbrevi fultis laxiusculis plurifloris fulvo-pubescentibus, bracteis rotundato-ovatis obtusis vel obtusissimis ut calyx puberulis margineque ciliatis, floribus sessilibus 5-meris, calycis lobis late ovatis obtusissimis, corollæ tubo calyci æquilongo late cylindrico faucibus albo-villosis lobis oblongo-ovatis acutis tubum æquantibus, filamentis complanatis quam antheræ oblongo-ovatæ basi sagittulatæ barbatæque brevioribus, ovario ovoideo in stylum crassum æquilongum desinente, bacca parva subsphæroidea levi monosperma, semine oblongo-ovoideo dorso ventroque aliquanto complanato albumine corneo.

Hab. Chirinda Forest 3700–4000 ft.; in fl. Jan., fr. Oct.; nos. 17, 17 *a*.

Folia vulgo 5·5–8 cm. long., 2–3 cm. lat., raro 10 × 4 cm. attingentia; jugum proximale triente inferiore ad 2–3 mm. a margine percurrens, superne crebro arcuato-anfractuosum; jugum distale ad 1–1·8 cm. a basi insertum primo rectum deinde arcuatum et cum ordinis secundi costis circa 5–6 costulisque numerosis anastomosantibus; costularum rete utrinsecus prominens sed foliorum vetustiorum pagina superiore sæpe minus aspectabile. Flores flavi. Calyx 1·5 mm. long. Corollæ 3 mm. long.; tubus 1·5 mm. long., ægre 2 mm. lat.; lobi 1·5 × 1·2 mm. Filamenta 0·5 mm., antheræ vix 1 mm. long. Ovarium 0·9 mm. long. Bacca viva flava, in sicco 1·3–1·4 cm. long., 1·2–1·3 cm. diam. Semina fusca vel fusco-rubra, 9 × 7 mm.

Mr. Swynnerton notes this as one of the largest trees of the Melsetter district. The yellow fruits are eaten by birds, squirrels and monkeys. Flowers a creamy Naples yellow in colour. The forest Touracos (*Turacus livingstonii*) are particularly fond of the berries, which are borne very abundantly.

STRYCHNOS (§ Intermediæ) MELLODORA, *S. Moore*, sp. nov.

Arbor mediocri altitudine ramulis ascendentibus validis crebro foliosis cito glabris cortice brunneo-rubescente nitido obductis, foliis oblongo-oblanceolatis apicem versus sæpe cuspidato-attenuatis apice obtusis basi in petiolum brevem cuneatim coartatis tenuiter coriaceis glabris basi ipsa jugo proximali tenui adjecto trinervibus jugo distali validiore ad 5–10 mm. supra basin costæ centrali inserto costis secundariis reliquis utrinque 4–6 primo ascendentibus marginem versus late arcuatis necnon leviter anfractuosis, floribus in cymas paniculatas axillares pedunculatas multifloras fulvo-pubescentes dispositis, bracteis ovatis obtusis pedicellis brevioribus, floribus tetrameris, calycis lobis rotundato-ovatis obtussisimis margine ciliolatis, corollæ tubo abbreviato sc. calyce breviore limbi lobis anguste ovato-oblongis obtusis tubum 4-plo excedentibus intus albo-villosulis, filamentis complanatis corollæ lobos semiæquantibus, ovario glabro stylo crassiusculo longiore, bacca ——.

Hab. Chirinda Forest, 3700–4000 ft.; in fl. Oct.; n. 101.

Folia sæpius 8–10 × 3–4 cm., in sicco plus minus castanea, pag. sup. nitida; jugum proximale nullo negotio aspectabile etsi tenue, apicem versus evanescens; costularum rete laxiusculum, utrinque satis prominens. Cymæ solemniter 2·5–3·5 cm. long., 3–3·5 cm. diam. Pedunculus communis 7–12 mm. long.; pedd. partiales vulgo 5–10 mm., raro usque ad 15 mm.; pedicelli 1–2 mm. long. Bracteæ circa 1 mm. long. Flores albi, mellis odorem spargentes. Calyx 1 mm. long. Corollæ tubus 0·6 mm. long, 1·25 mm. lat.; lobi 2·5 mm. long. Filamenta 1·2 mm. long.; antheræ oblongæ 0·7 mm. long. Ovarium fere 1 mm. long., stylus 0·4 mm.

Near *S. alnifolia*, Baker, but different in habit, form and nervation of the leaf, and the short tube of the corolla.

STRYCHNOS BURTONI, *Bak. in Kew Bull.* 1895, 98.
Chirinda, Chibabava and Boka ; in fl. Dec. ; nn. 1959, 1960, 1961.
Distrib. Tropical East Africa from Zanzibar southward.
A large tree with edible fruits. Chindao name, "Mukwakwa."

Gilg (Engl. Bot. Jahrb. xxxvi. 93) considers *S. Burtoni* conspecific with *S. dysophylla*, Benth. He cannot have seen the types in the Kew Herbarium, there being too many points of difference to leave any doubts as to the distinctness of *S. Burtoni*.

S. SPINOSA, *Lam. Ill.* ii. 38.
Near Chirinda, 3800 ft. ; in fl. Oct. ; nn. 55, 55 *a*.
Distrib. Tropical and South Africa, Mascarene Islands.
This is the Kafir Orange. Chindao name, "Mutamba."

ANTHOCLEISTA ZAMBESIACA, *Bak. in Kew Bull.* 1895, 99.
Mt. Maruma, 3500 ft. ; in fl. Dec. ; n. 27.
Distrib. Nyasaland.
A large and particularly striking tree not uncommon in wooded glens ; flowers white. Chindao name, "Muzama."

GENTIANEÆ.

SEBÆA LEIOSTYLA, *Gilg in Engl. Bot. Jahrb.* xxvi. (1898) 97.
Melsetter, 6000 ft. ; in fl. April ; n. 1898.
Distrib. Nyasaland.

BELMONTIA GRANDIS, *E. Mey. Comm.* ii. 183.
Source of Chipetzana, 4000 ft. ; in fl. April ; n. 2031.
Distrib. S. Africa and northward to Uganda.

CHIRONIA TRANSVAALENSIS, *Gilg in Engl. Bot. Jahrb.* xxvi. (1898) 106.
Zinqumbo Hills at 1500 ft. ; in fl. Nov. ; n. 1891.
Distrib. Northern South Africa extending to Rhodesia and Congo Free State.

CHIRONIA (§ Plocandra) GRATISSIMA, *S. Moore*, sp. nov.
Glabra, caule erecto ramoso affatim foliifero, foliis quam internodia sæpissime brevioribus oblongo-lanceolatis rarius ovato-oblongis juxta apicem sæpissime attenuatis apice ipso obtusis nonnunquam obtusissimis basi levissime amplexicaulibus trinervibus, floribus pro rata magnis in cymis laxis paucifloris bracteis lanceolatis acutis onustis digestis, calycis plane ultra medium divisæ lobis lineari-lanceolatis acutis dorso parum carinatis, corollæ tubo calycem paullulum excedente lobis tubum 3-plo excedentibus anguste oblongo-obovatis obtusis, antheris late oblongis a basi spiraliter tortis, ovario ovoideo-oblongo apice coartato, stylo crasso superne fere recto stigmate bilobo terminato.

Hab. Melsetter, 6000 ft.; Northern Melsetter at 5000–6000 ft.; in fl. Sept., Oct.; nn. 1892, 6162.

Planta saltem bispithamea. Internodia solemniter 5–7 cm. long. Folia radicalia desunt; caulina vulgo 3–4 cm. long., 10–17 mm. lat., perpauca summa immunita, nec in bracteas non transeuntia. Cymæ 12–15 × 10–12 cm.; pedunculus communis circa 6 cm. long., pedunculi partiales 2–5 cm. Flores saturate purpurei. Calycis pars indivisa 2 mm., lobi 6 mm. long. Corolla profecto pansa 3·5 cm. diam.; tubus 6 × 5 mm.; lobi ægre 18 mm. long., apicem versus margine leviter crispuli. Filamenta 3 mm. long.; antheræ inter sese paullulum inæquales, 6·5–7·5 mm. long. Ovarium 1 cm. long.; stylus vix totidem; stigma in toto 1·75 mm. long., hujus lobi 1·2 mm.

This fine plant has its nearest affinity in *C. laxiflora*, Bak., which is of more slender habit, and bears smaller ovate leaves and smaller flowers with the lobes of the calyx lengthily acuminate and strongly keeled on the back.

Enicostema littorale, *Blume, Bijdr.* 848.
Lower Umswirizwi River, 1000 ft.; in fl. Nov.; n. 2032.
Distrib. Tropical and South Africa, East Indies.

Swertia stellarioides, *Ficalho, Pl. Uteis*, 225.
Melsetter, 6000 ft.; in fl. April; n. 1919.
Distrib. Transvaal, Rhodesia, Angola.

Limnanthemum Thunbergianum, *Griseb. Gen. & Sp. Gent.* 345.
Upper Umswirizwi, near Chirinda, 2589 ft.; in fl. & fr. Oct.; n. 393.
Distrib. S. Africa and northward to Mozambique and Angola.

BORAGINEÆ.

The collection includes specimens of *Heliotropium indicum*, Linn., a common weed in the tropics of both hemispheres, also of *H. zeylanicum*, Lam., and *Cynoglossum lanceolatum*, Forsk., both widely distributed in the Old World.

Ehretia divaricata, *Bak. in Kew Bull.* 1894, 28.
Chirinda Forest, 3700–4000 ft., Chikambogé Valley, 3000 ft.; in fl. & fr. Sept., Oct.; nn. 8, 1416.
Distrib. Nyasaland.

E. Stuhlmanni, *Gürke in Engl. Pflanzenw. Ost-Afr.* C. 336.
Chibabava and Boka, Lower Buzi; in fl. & fr. Dec.; nn. 1412, 1412 *a*.
Distrib. Tropical East Africa.

Trichodesma zeylanicum, *R. Br. Prod.* 496.
Chibabava, Lower Buzi, 400 ft.; in fl. Nov.; n. 1942.
Distrib. Tropical Africa and Mascarene Islands: also in East Indies and Australia.

TRICHODESMA PHYSALOIDES, *A. DC. in DC. Prod.* x. 173.

Umvumvumvu River and Nyahodi Valley, at 4000 ft.; in fl. Oct.; nn. 2112, 6003.

Distrib. Tropical and South Africa.

CONVOLVULACEÆ. (Dr. RENDLE.)

HEWITTIA BICOLOR, *Wight in Madras Journ. Sc.* ser. 1, v. (1837) 22.

Outskirts of Chirinda, 3700–4000 ft.; Kurumadzi River, Jihu, 2000 ft.; in fl. June, Nov.; nn. 1187, 1797.

Distrib. Tropical Africa and Natal; also Tropical Asia.

CONVOLVULUS SAGITTATUS, *Thunb.*, var. ABYSSINICUS, *Hall. fil. in Bull. Herb. Boiss.* vi. 533.

Near Chirinda, 3500 ft.; in fl. June; n. 1798. A climbing herb with small pinkish-white flowers.

Distrib. East tropical Africa, Angola.

ASTROCHLÆNA MALVACEA, *Hall. fil. in Engl. Bot. Jahrb.* xviii. (1894) 321.

Near Chirinda, 3800 ft.; Chikambogé Valley, 3000 ft.; in fl. Sept., Dec.; nos. 300, 1799.

Distrib. South-East tropical Africa; South Africa.

Var. EPEDUNCULATA, *Rendle in Fl. Trop. Afr.* iv. Sect. 2, 122.

South Umtali District, Melsetter Road, at 2000–3000 ft.; in fl. Oct.; n. 6603.

Distrib. Rhodesia.

IPOMŒA GRACILIOR, *Rendle in Journ. Bot.* xlvi. (1908) 180.

Swampy ground, Mt. Maruma, 3500 ft.; in fl. Sept.; n. 782.

Distrib. Uganda Protectorate.

I. CALYSTEGIOIDES, *E. Mey. in Drège, Zwei Pflanz. Doc.* 195.

Lower Umswirizwi, 1000 ft.; in fl. Nov.; n. 312.

Distrib. South Africa.

I. WIGHTII, *Choisy in Mém. Soc. Phys. Genèv.* vi. (1833) 470.

Outskirts of Chirinda, 3800 ft.; Melsetter at 6000 ft.; in fl. April, June; nn. 783, 1165.

Distrib. East tropical Africa, South Africa, Madagascar; Tropical Asia.

I. WELWITSCHII, *Vatke ex Hallier f. in Engl. Jahrb.* xviii. (1894) 146.

Near Chirinda, 3500 ft.; in fl. Nov.; n. 301.

Distrib. South tropical Africa.

CUSCUTA KILIMANJARI, *Oliver in Trans. Linn. Soc.* ser. 2, *Bot.* ii. (1887) 343.

Chirinda, 3800 ft.; in fl. May; n. 453.

Distrib. Mt. Kilimanjaro.

SOLANACEÆ.

SOLANUM BIFURCUM, *Hochst. in Flora*, xxiv. I. (1841) Intell. 24.
Chirinda Forest, 3700 ft.; in fl. Oct.; n. 86.
Distrib. Abyssinia to Angola and Mozambique; also in South Africa.

S. PANDURÆFORME, *E. Mey. in Drège, Zwei Pflanz. Doc.* 147.
Chibabava, Lower Buzi, 400 ft.; Kurumadzi River, Jihu, 2000 ft.; in long grass near Chirinda, 3800 ft.; fl. Nov.; nn. 387, 1792, 1793. N. 1793 is almost or quite spineless.
Distrib. Uganda to Angola and Rhodesia.

S. NODIFLORUM, *Jacq. Ic. Pl. Rar.* ii. 11, t. 326.
Melsetter, 6000 ft.; Chirinda Forest, 3800 ft.; cultivated ground near Chirinda; in fl. & fr. April, May; nn. 342, 481, 1794.
Distrib. Tropical Africa.

S. INDICUM, *Linn. Sp. Pl.* 187.
Cultivated ground near Chirinda, 3800 ft.; in fl. Oct., in fr. May; nn. 388, 482.
Distrib. Tropical Africa, Transvaal, Mascarene Islands; widely distributed in Asia.

S. ACANTHOCALYX, *Klotzsch in Peters Mossamb. Bot.* 232.
Chirinda Forest, 3700–4000 ft.; in fl. Nov.; n. 93.
Distrib. Nyasaland, Mozambique, Madagascar.

S. ACULEASTRUM, *Dun. in DC. Prod.* xiii. I. 366.
A single specimen without number or locality.
Distrib. Uganda to Nyasaland, South Africa.

WITHANIA SOMNIFERA, *Dun. in DC. Prod.* xiii. I. 453.
Kurumadzi River, Jihu, 2000 ft.; in fl. & fr. Nov.; n. 1791.
Distrib. Tropical South Africa and Canaries to India.

SCROPHULARIACEÆ.

Torenia parviflora, Ham., a common tropical weed, was collected by Mr. Swynnerton at Beira.

HALLERIA LUCIDA, *Linn. Sp. Pl.* 625.
Chirinda Forest, 3700–4000 ft.; Melsetter, 6000 ft.; in fl. Sept., Dec.; nn. 124, 1138.
Distrib. South Africa and northward to Abyssinia.

Teedia lucida, *Rud. in Schrad. Journ.* ii. (1799) 228.
Crags of the Chimanimani Mts. at 7000 ft.; in fl. Sept.; n. 785.
Distrib. S. Africa.
The genus has not hitherto been recorded as tropical.

Freylinia tropica, *S. Moore*, sp. nov.
Ramis ramulisque tetraquetris cito glabris novellis viscidis, foliis breviter petiolatis oblongo-oblanceolatis obtusis vel obtusiusculis basi attenuatis margine sæpius ultra medium pauci- vel perpaucidenticulatis coriaceis utrobique glabris, cymis 2–5-floris viscidis, bracteis parvulis quam pedicelli sæpissime brevioribus linearibus obtusis, calyce pedicellum vulgo breviter excedente viscido, corollæ extus glanduloso-puberulæ intus glabræ tubo calycem triplo excedente superne leviter amplificato lobis suborbicularibus, antheris ovatis obtusis, ovario oblongo-ovoideo ut stylus crassiusculus glabro.
Hab. Melsetter, 6000 ft.; in fl. Sept.; n. 608.
Folia 1·5–3 cm. long., 6–9 mm. lat., in sicco viridia vel viridi-grisea, pagina inferiore pallidiora; costa media supra impressa, subtus optime eminens; costæ ordinis secundi utrinque 2–3, parum aspectabiles; petioli 2–3 mm. long. Cymæ floribus haud exemptis 1–1·5 cm. long.; bracteæ ± 1·5 mm., pedicelli vulgo 1·5–2·5 mm. long. Calyx 3-4 mm. long. Corollæ tubus 10–11 mm. long., inferne 2 mm. ore 3·5 mm. lat.; lobi circiter 5 × 5·5 mm. Staminum altiorum filamenta fere 2 mm. long., reliquorum fere 3 mm.; antheræ 1 mm. long, Discus 0·5 mm. alt. Ovarium ægre 2 × 0·8 mm.; stylus 9 mm. long.
This was at first supposed to be the type of a new genus allied to *Capraria*, but I now think there can be no doubt as to its place being in *Freylinia*, as Miss Kensit suggested to me. The reason for my former view was that *F. tropica* certainly has the æstivation of *Digitaleæ*, not of *Cheloneæ*, and I naturally accepted the statement that the æstivation of *Freylinia* is that of *Cheloneæ*. However, examination has led me to doubt the accuracy of that statement, and it seems to me that the proper place for *Freylinia* is in *Digitaleæ* near *Capraria*, though the point, it must be admitted, is difficult to decide from dried material alone.
As the trivial name implies, this South African genus has not hitherto been recorded as tropical.

Zaluzianskya capensis, *Walp. Rep.* iii. 387.
Melsetter, 6000 ft.; in fl. Sept.; n. 1981.
Distrib. South Africa.
The first tropical record for the genus.

Sutera Carvalhoi, *Skan in Fl. Trop. Afr.* iv. Sect. 2, 307.
Melsetter, 6000 ft.; Northern Melsetter at 5000–6000 ft.; in fl. Sept., Oct.; nn. 1980, 6228.
Distrib. Mozambique, Rhodesia.

SUTERA FLORIBUNDA, *O. Kuntze, Rev. Gen. Pl.* ii. 467.

Melsetter and Northern Melsetter, 5000–6000 ft.; fl. Sept., Oct.; nn. 1996, 6149.

Distrib. South Africa.

An addition to the Tropical African flora.

LINDERNIA FLAVA, *S. Moore*, sp. nov.

Verisimiliter annua, glabra, caule ascendente sursum ramoso anguste tetraptero, foliis omnibus oppositis sessilibus ovatis acutis obtusisve basi cordato-amplexicaulibus margine distanter dentatis dentibus induratis 5-nervibus, floribus axillaribus solitariis pedunculis quam calyx sæpe brevioribus suffultis, calycis anguste campanulati tubo quam lobi anguste lineari-lanceolati acuminati juxta basin ciliolati paullo breviore, corollæ tubo calyce breviore cylindrico labio postico obovato breviter bilobo quam anticum manifeste breviore extus pubescente labii antici lobis obovatis obtusissimis margine crispulis, staminibus posticis subinclusis anticorum appendice abbreviata incurva crassiuscula antherum loculis haud confluentibus.

Hab. Mt. Maruma, 3500 ft., in swamp; near Chirinda, 3700 ft.; in fl. June, Sept.; nn. 1922, 1966.

Folia summum 1·3 × 1·2 cm., sed sæpissime minora, *e. g.* 7 × 5 mm., ima basi ciliolata, in sicco haud decoloria, membranacea, glandulis immersis satis copiose prædita. Pedunculi sæpius circa 5 mm. long. Flores saturate flavi. Calyx in toto 7 mm. long.; tubus 3 mm. long., superne 2 mm. lat., inter costas 5 eminentes pallescens; lobi 4 mm. long. Corollæ tubus 4 mm. long.; labium posticum 2 mm., anticum 4 mm. long. Ovarium ovoideo-oblongum, apice attenuatum, 2 mm. long.; stylus ægre 5·5 mm., stigmatis lobi deltoidei, ciliolati, 0·75 mm. long.

Remarkably like *L. Gossweileri*, S. Moore, for which, on a hasty view, it might easily be mistaken; but that plant's calyx is divided to the base and, among other points, its corollas are larger and have a longer tube, while the upper lip is but little shorter than the lower, instead of being only half as long.

ALECTRA COMMUNIS, *Hemsl. in Fl. Trop. Afr.* iv. Sect. 2, 372.

Outskirts of Chirinda, 3700–4000 ft.; in fl. June; n. 1975.

Distrib. Nigeria and Uganda to Nyasaland.

BUCHNERA HENRIQUESII, *Engl. Bot. Jahrb.* xviii. (1894) 69.

Near Chirinda, 3800 ft.; Melsetter, 6000 ft.; Kurumadzi River, Jihu, 2000 ft.; Upper Buzi at 3500 ft.; Mt. Pene, 7000 ft.; in fl. May, July, Oct., Nov.; nn. 303 *a*, 1982, 1983, 6106, 6109.

Distrib. Angola to Rhodesia.

Buchnera Lastii, *Engl. Pflanzenw. Ost-Afr.* C. 359.
Mt. Pene, 7000 ft.; in fl. Oct., Nov.; nn. 6105, 6150.
Distrib. Nyasaland.

Cycnium adoense, *E. Mey. ex Benth. in Hook. Comp. Bot. Mag.* i. (1835) 368.
Near Chipete forest patch, 3800 ft.; Melsetter at 6000 ft.; in fl. April, Oct.; nn. 234, 6076.
Distrib. Tropical East Africa from Uganda southward.

Rhamphicarpa tubulosa, *Benth. l. c.*
Open woods at Beira; in fl. Dec.; n. 1984.
Distrib. Uganda and British East Africa to Amboland and Rhodesia. Also in South Africa.

Striga orobanchioides, *Benth. l. c.* 371.
Chibabava, Lower Buzi, 400 ft.; in fl. Jan.; n. 1413.
Distrib. Tropical and South Africa, Arabia, India.

S. lutea, *Lour. Fl. Cochinch.* 22.
Upper Buzi, 3000 ft.; Umswirizwi River at 1000 ft.; in fl. & fr. Apr., Nov.; nn. 1985, 2137.
Distrib. Tropical and South Africa, Mascarene Islands, Tropical Asia.

S. Forbesii, *Benth. in Hook. Comp. Bot. Mag.* i. (1835) 364.
Umswirizwi River at 1000 ft.; in fl. Nov.; n. 1986.
Distrib. Tropical and South Africa, Madagascar.

S. pubiflora, *Klotzsch in Peters Mossamb. Bot.* 227.
Beira; in fl. Dec.; nn. 1451 *a*, 1951.
Distrib. Tropical East Africa from British East Africa to Nyasaland and Rhodesia.

Sopubea ramosa, *Hochst. in Flora*, xxvii. (1844) 27.
Near Chirinda, 3800 ft.; Chipetzana and Upper Buzi Rivers, at 3000 ft.; fl. & fr. Apr., June; nn. 389, 2125, 2126.
Distrib. Tropical Africa.

S. simplex, *Hochst. l. c.*
Mt. Pene, 6500–7000 ft.; in fl. Sept., Oct.; nn. 1976, 6209.
Distrib. Tropical and South Africa.

Bopusia scabra, *Presl in Abhandl. Böhm. Gesell. Wiss.* iii. (1846) 521.
Mt. Pene, 6500–7000 ft.; hills near Haroni River at 5500 ft.; in fl. Sept., Oct.; nn. 1977, 1978, 6077.
Distrib. South Africa.
Another addition to the Tropical African flora, genus as well as species.

BIGNONIACEÆ.

PODRANEA BRYCEI, *Sprague in Fl. Trop. Afr.* iv. Sect. 1, 515.

Common in wooded kloofs, Chipete Forest Patch, 3800 ft.; in fl. May; n. 429.

Distrib. Rhodesia.

STEREOSPERMUM KUNTHIANUM, *Cham. in Linnæa*, vii. (1832) 721.

Boka, Lower Buzi, 100 ft.; in fl. Dec.; n. 1130.

Distrib. Tropical Africa.

MARKHAMIA ACUMINATA, *K. Schum in Engl. Pflanzenw. Ost-Afr.* C. 363.

Boka and Chibabava, Lower Buzi; in fl. Dec.; nn. 1475, 1475 *a*.

Distrib. Mozambique to Bechuanaland.

A somewhat small tree with deep brownish-purple flowers and a durable timber used for rafters, &c. Chindao name, "Musiramyati."

M. LANATA, *K. Schum. in Engl. & Prantl, Pflanzenfam.* iv. 3 B, 242.

Upper Buzi at 3000 ft.; in fl. Dec.; n. 33.

Distrib. German East Africa, Congo Free State, Nyasaland.

Chindao name, "Mubfeya." A smallish tree, usually 25 feet high. The wood is a favourite with native bowyers. Roots said to be used, cooked, for fever and colic. Bark employed as a substitute for rope.

KIGELIA PINNATA, *DC. Prod.* ix. 247.

Delagoa Bay; n. 6516.

Distrib. Mozambique, Nyasaland, Rhodesia.

Owing to insufficiency of material some doubt rests upon this identification. N. 1132, from Sabi River at about 1000 ft., should most probably be referred here.

PEDALINEÆ.

SESAMUM INDICUM, *Linn. Sp. Pl.* 634.

Cultivated ground near Chirinda, 3800 ft.; Upper Buzi at 3000 ft.; in fl. April, May; nn. 251, 2000.

Distrib. Tropical Africa, and generally cultivated in the tropics.

S. ALATUM, *Thonn. in Schum. & Thonn. Beskr. Guin. Pl.* 284.

Madanda forests at about 400 ft.; in fl. Dec.; n. 1890.

Distrib. Tropical Africa.

CERATOTHECA TRILOBA, *E. Mey. ex Bernh. in Linnæa*, xvi. (1842) 29.

Northern Melsetter, 5000–6000 ft.; in fl. Oct.; n. 6221.

Distrib. A South African plant ranging northward to Rhodesia.

ACANTHACEÆ.

PSEUDOCALYX AFRICANUS, *S. Moore*, sp. nov.

Scandens, ramis robustis subteretibus fulvo-tomentosis dein glabris, foliis petiolatis oblongo-ovatis breviter cuspidulatis et obtusis vel apice obtusissimis basi rotundatis margine undulatis vel obscure denticulatis coriaceis supra pilis stellatis scabriusculis subtus præsertim secus nervos stellato-pubescentibus, racemis terminalibus folia excedentibus multifloris validis fulvo-tomentosis folia floralia normalibus consimilia nisi minora gerentibus, pedicellis quam bracteolæ paullo brevioribus reflexis, bracteolis inferne connatis subrotundatis obtusissimis ut pedicelli persistenter arcte ferrugineo-tomentosis intus strigoso-puberulis, calyce cupuliformi longitudine ovarium semiæquante extus fulvo-tomentoso intus glabro nitenteque, corollæ extus dense stellato-fulvo-pubescentis tubo calycem subæquante superne parum amplificato limbi lobis 2 posticis obovatis obtusissimis quam antici inter se fere æquales plane majoribus, antheris juxta medium tubum insertis subinclusis subsessilibus longitrorsum hispidulis, pollinis granis normalibus, ovario ambitu rotundo compresso fulvo-tomentoso, stylo exserto glabro, stigmatis lobis lineari-oblongis parum excavatis, fructu ignoto.

Hab. Chirinda Forest at 3800 ft. ; in fl. May ; n. 97.

Foliorum limbus 8–14 cm. long., 5–8 cm. lat. ; costæ secundariæ utrinque circa 6, apertissime arcuatæ, ut costulæ utrobique præsertim vero pagina inferiore perspicuæ, supra in sicco olivaceo-brunneus subtus pallidior ; folia floralia ætate juvenili utrinque fulvo-tomentosa, 0·5–5 cm. long. Pedicelli summum 1·2 cm. long. Bracteolæ 1·5 cm. long., ægre totidem lat., pars connata 6 mm. long. Flores extus dilute punicei intus sordide albescentes. Calyx 2 mm. alt. Corollæ tubus circa 1·4 cm. long., ima basi 0·6 cm., faucibus 1·1 cm. diam., intus superne ut lobi facie interiore pilis hispidulis decurvis copiose munitus ; lobi postici 1·3 × 1·3 cm., antici 6 × 4–5 mm. Filamenta crassiuscula, 1·5 mm. long. ; antherarum loculi inter se æquales, 9 mm. long., juxta apicem parum attenuati. Ovarium 4 × 4 mm. ; stylus 1·8–2 cm., stigmatis lobi 2 mm. long.

Closely allied to the only species hitherto known, viz. *P. saccatus*, Radlk., a native of Madagascar, thus marking an interesting extension of the genus to the African continent. From *P. saccatus* it can be distinguished, among other features, by the relatively broader leaves, the long terminal racemes, the broader bracteoles, and the much smaller corolla.

THUNBERGIA ALATA, *Boj. ex Sims*, *Bot. Mag.* t. 2591.

Outskirts of Chirinda, 3700–4000 ft. ; Chipete forest patch, 3800 ft. ; in fl. Jan., May ; nn. 353, 452.

Distrib. Tropical Africa, Natal.

THUNBERGIA RANDII, *S. Moore in Journ. Bot.* xxxviii. (1900) 201.

Umvumvumvu River at 4000 ft.; Mt. Pene, 7000 ft.; in fl. Oct.; nn. 6098, 6216.

Distrib. Rhodesia.

T. LANCIFOLIA, *T. And. in Journ. Linn. Soc.* vii. (1864) 19.

Nyahodi River at 5000 ft.; in fl. Sept.; n. 1925.

Distrib. Angola to Rhodesia and German East Africa.

THUNBERGIA SWYNNERTONII, *S. Moore*, sp. nov.

Verisimiliter scandens caule sat gracili erecto puberulo dein glabro nodis aliquanto tumidis barbatis, foliis longipetiolatis amplis late ovato-lanceolatis acuminatis basi cordatis 3- vel 5-nervibus basin versus undulato-denticulatis ceteroquin integris tenuiter membranaceis utrinque fere omnino glabris in sicco læte viridibus, floribus mediocribus in racemos breves terminales bracteatos dispositis vel solitariis et axillaribus, bracteis foliaceis subsessilibus lanceolatis, pedicellis bracteolas multo excedentibus glabris, bracteolis oblongo-lanceolatis acutis pilis glandulosis longiusculis albis hirsutulis decoloribus costulis viridibus reticulatis percursis, floribus albis, calycis parvi arcte minutissime sericei ore breviter 6–8-dentato, corollæ tubo bracteolas faciliter superante inferne comparate attenuato superne amplificato limbi lobis corollæ tubum semiæquantibus, antherarum unius staminum (floris a me scrutati) loculo altero basi incurvo-calcarato altero brevissime calcarato alterius paris loculis ambobus muticis vel basi solummodo mucronulatis, ovario late ovoideo compresso minutissime sericeo, stigmate lato infundibulari triangulari ad angulos anticos barbellato, capsula parva sat longirostrata sericea rostro sæpe plus minus curvato.

Hab. Chirinda Forest at 3700–4000 ft.; *Swynnerton*, 339.

Internodia sæpissime 3–6 cm. long. Foliorum limbus 9–12 × 4–5·5 cm. (accedunt revera folia pauca in bracteas transeuntia circa 5 cm. long.), pagina superiore pilis sparsis strigosis appressis instructus, pagina inferiore scabriusculus; petioli 6 cm. long. vel minus. Racemi circa 4 cm. long. Bracteæ 0·3–3 cm. long., sc. summæ valde imminutæ. Pedicelli tandem 2·5–3·5 cm. long. Bracteolæ 1·5–2·5 cm. long., 8 mm. lat. Calyx 1 mm. alt. Corollæ tubus circa 3 cm. long., superne 1 cm. diam.; limbi lobi circa 1–1·5 cm. long. Filamenta complanata, 6–8 mm. long.; connectivus acuminatus; antherarum loculi subquadrati, secus suturam ciliati, 2 mm. long. Ovarium 1·5 mm. long., 1·25 mm. lat.; stylus vix 1·5 cm. long.; stigma fere 5 mm. long., circa 4 mm. lat. Capsula inferne 6 × 8 mm., rostrum 1·1–1·2 cm. long. Semina compressa, ventre plana, foveolata, brunnea, 4·5 × 3·2 mm.

A difficult plant to place in any of Lindau's four sections. The stigma is that of § *Thunbergiopsis*, but the flowers of that section are always axillary, while in § *Pseudhexacentris*, with the same stigma, the flowers are usually

borne on small axillary branches. The difficulty is emphasised by the fact of one of the specimens—a fruiting one—having its flowers solitary and axillary. This tends to show that the inflorescence does not yield a good sectional character for *Thunbergia.*

Var. CORDATA, *S. Moore*, var. nov. Folia eximie cordata, juxta basin utrinque 3-lobulata, ceteroquin integra vel repanda, petiolis adusque 10–11 cm. long. fulta. Bracteolæ circa 15 × 6 mm.

Portuguese E. Africa, Kurumadzi River, Jihu, at 2000 ft.; nn. 1924, 1926.

N. 1924 is a form with blue flowers; the flowers of 1926 are white.

BRILLANTAISIA GRANDIDENTATA, *S. Moore in Journ. Bot.* xlv. (1907) 331.

Mt. Pene, 6500–7000 ft.; in fl. Sept.; nn. 336, 1145.

Distrib. Uganda.

RUELLIA OVATA, *Thunb. Prod.* 104.

Near Chirinda, 3500 ft.; in fl. Nov.; n. 1931.

Distrib. South Africa.

This is an addition to the flora of Tropical Africa.

MELLERA LOBULATA, *S. Moore in Journ. Bot.* xvii. (1879) 225.

Outskirts of Chirinda, 3700–4000 ft.; Mt. Maruma, 3500 ft.; in fl. June, Sept.; nn. 1141, 1923.

Distrib. Uganda to Nyasaland.

CHÆTACANTHUS PERSOONII, *Nees in Linnæa*, xv. (1841) 357.

Chirinda, 3800 ft.; in fl. April; n. 377.

Distrib. A South African plant now known to range as far northward as Uganda.

PHAYLOPSIS PARVIFLORA, *Willd. Sp. Pl.* iii. 342.

Kurumadzi River, Jihu, 2000 ft.; Inyamadzi Valley, 2500 ft.; in fl. Aug., Sept.; nn. 1927, 1928.

Distrib. Tropical Africa.

P. LONGIFOLIA, *T. Thoms. in Speke Journ. Append.* 643.

Melsetter, 6000 ft.; outskirts of Chirinda, 3700–4000 ft.; in fl. June, Sept.; nn. 1929, 1930.

Distrib. Tropical Africa.

BLEPHARIS MADANDENSIS, *S. Moore*, sp. nov.

Ramis teretibus frequenter foliosis griseo-pubescentibus, foliis in pseudoverticillos 4-natos plerumque dispositis quorum 2 cetera plane excedunt linearibus vel anguste lineari-lanceolatis foliis abbreviatis late oblongis oblongo-ovatisve omnibus spinuloso-acuminatis basi obtusis margine dentibus

spinulosis paucis instructis nonnunquam fere integris subcoriaceis supra scabridis subtus griseo-pubescentibus, inflorescentiis griseo-pubescentibus capitula brevia globosa levissimeve cylindracea pluriflora referentibus, bracteis sterilibus lineari-lanceolatis spinuloso-acuminatis ut bractea fertilis bracteolæque oblongæ pubescentes illas multo excedentes margine spinuloso-dentatis, calycis pubescentis lobis anticis anguste ovato-oblongis sat alte connatis sub apicibus spinoso-acuminatis unidentatis lobo postico anticos plane superante lanceolato superne attenuato spinoso-acuminato lobis lateralibus lineari-lanceolatis longe acuminatis lobi postici dimidium excedentibus, corollis cæruleis limbi pubescentis 3-lobi lobo intermedio lanceolato obtuso quam laterales ovato-oblongi obtusissimi manifeste minore, capsula oblongo-ovoidea compressiuscula obtusa 2-sperma.

Hab. Madanda forests at about 400 ft. ; in fr. Dec. ; n. 1952. [Also at Kew, Maconi, Madanda ; *Archdeacon Johnson*, 98.]

Folia majora 5–9 cm. long., 5–9 mm. lat. ; minora 5–20 × 3–5 mm. Capitula 2·5–3 cm. long., 3–3·5 cm. lat. Bracteæ steriles ± 1 cm. long. Bracteæ fertiles necnon bracteolæ 2·2 cm. long. Calycis lobi antici 2·5 cm. long. ; horum pars libera 6·5 mm. long. ; lobi laterales 2·2 cm. long. ; lobus posticus 3 cm. long. Corollæ tubus 7 mm. long. ; limbus 3·2 cm. long., juxta apicem 1·8 cm. lat., lobus intermedius 5 × 4·5–5 mm. Filamenta 9–10 mm. long. ; antica ægre 4 mm. lat. ; antheræ 7·5 mm. long. Capsula 1 cm. long., 6 mm. lat., brunnea, perspicue nigro-lineata, polita. Semina 7 × 5 mm.

Among other features this differs from *B. panduriformis*, Lindau, in the indumentum, the short and compact heads of flowers, the small fertile bract, the large oblong (not small and linear) bracteoles, the longer lanceolate (not ovate-oblong) hinder lobe of the calyx, and the larger corollas.

Mr. Swynnerton's specimens being in fruit, the flowers have been described from that of Archdeacon Johnson.

SCLEROCHITON KIRKII, *C. B. Clarke in Fl. Trop. Afr.* v. 110.
Madanda forests at about 400 ft. ; in fl. Dec. ; n. 575.
Distrib. Zambesia.

S. HARVEYANUS, *Nees in DC. Prod.* xi. 279.
Chirinda Forest, 3700–3800 ft. ; Mt. Pene; in fl. May, Oct., Dec. ; nn. 424, 455, 6119, 6638.
Distrib. South Africa.

This, which is another addition to the tropical flora, Mr. Swynnerton notes as a shrub exceedingly plentiful in parts of the forest.

S. CÆRULEUS, *S. Moore*, comb. nov.
Pseudoblepharis cærulea, Lindau in Engl. Bot. Jahrb. xxx. (1901) 111.
Madanda forests, on ant-heaps at about 400 ft. ; in fl. Dec. ; n. 1144.
Distrib. Mozambique.

CRABBEA NANA, *Nees in DC. Prod.* xi. 162.
In short grass near Chirinda, 3800 ft.; in fl. April; n. 304.
Distrib. Zambesia, Nyasaland, South Africa.

C. VELUTINA, *S. Moore in Journ. Bot.* xxxii. (1894) 135.
Madanda forests at about 400 ft.; in fl. Dec.; n. 1142.
Distrib. Tropical East Africa.

ASYSTASIA COROMANDELIANA, *Nees in Wall. Pl. Asiat. Rar.* iii. 89.

Var. LINEARIFOLIA, *S. Moore*, var. nov. Folia anguste oblongo-linearia, obtusa, basi acuta, vulgo 4–5·5 cm. long., 5–6 mm. lat.; petioli 4–5 mm. long. Corollæ tubus 1 cm. long.

Open woods at Beira; in fl. Dec.; n. 1949.
Distrib. (of type). Tropical Asia and Africa.

BARLERIA (§ Acanthoidea) SWYNNERTONII, *S. Moore*, sp. nov.

Fruticosa, ramosa, ramulis ultimis satis abbreviatis pubescentibus tandem glabrescentibus novellis appresse hirsutulis, foliis brevipetiolatis parvulis ovato-oblongis vel oblongo-obovatis obtusis vel obtuse acutis basi obtusis firme membranaceis utrobique præcipue ad nervos puberulis cito glabris, floribus ad apicem ramulorum solitariis perpaucisve, bracteis quam calyx multo brevioribus lineari-subulatis acutis sæpius paullulum recurvis puberulis debiliter spinosis in sicco fuscis, calycis ad nervos appresse puberuli lobo antico postico subsimili ovato obtuso basi rotundatissimo margine undulato lobis lateralibus diminutis lineari-lanceolatis acuminatis, corollæ verisimiliter dilute purpureæ tubo a medio gradatim dilatato lobis obovatis obtusissimis quam tubus brevioribus, staminibus 2 breviter exsertis staminodiis —, ovario oblongo glabro, stylo superne incrassato glabro apice truncato, capsula oblonga sub apice subito constricta obtusa.

Hab. Open woods at Beira; in fl. & fr. Dec.; n. 1958.

Folia sæpissime 1·3–2·3 cm. long., 7–10 mm. lat.; petioli 2–3 mm. long. Bracteæ 2·5–4 mm. long. Calycis lobi exteriores herbacei, leviter marcescentes, deinde decolores, eleganter plurinervosi, sub flore 1·5–1·7 × 1·1–1·2 cm., deinde usque ad 2·4 × 1·3 cm., pallidissime nitentes, paullo post florítionem papyracei et brunnei; lobi laterales circa 5 mm. long. Corolla tota 4 cm. long.; tubus inferne 2·5 mm. diam., superne adusque 12 mm.; limbus 13 mm. long. Antheræ 3 mm. long. Ovarium 2·75 mm. long.; stylus 2·7 cm. long., apice 0·75 mm. crass. Capsula 12 × 4·5 mm. Semina 2–2·5 × 2 mm.

This has much the appearance of *B. querimbensis*, Klotzsch, a species without spiny bracts, and on this account placed in a different part of the genus. Besides this, it is easily distinguished from *B. querimbensis*, which has considerably larger, distinctly cordate outer calyx-lobes. The nearest affinity seems to be with *B. grandicalyx*, Lindau.

ERANTHEMUM SUBVISCOSUM, *C. B. Clarke in Fl. Trop. Afr.* v. 173.
Chirinda Forest, 3700–4000 ft.; in fl. Oct.; n. 130.
Distrib. Nyasaland, Mozambique.
A common flowering plant of the forest, 2–3 feet in height.

JUSTICIA BETONICA, *Linn. Sp. Pl.* 21.
Chirinda; Chimanimani Mts., 7000 ft.; Mt. Pene, 7000 ft.; in fl. June, July, Sept., Oct.; nn. 136, 1121, 1987, 6120.
Distrib. Tropical Africa and Asia.

J. MELAMPYRUM, *S. Moore in Trans. Linn. Soc.* ser. 2, *Bot.* iv. (1894) 32.
Outskirts of Chirinda, 3700–4000 ft.; Madanda forests, 400 ft.; in fl. May, Dec.; nn. 505, 506, 1950.
Distrib. Uganda to Angola and Rhodesia.

J. MATAMMENSIS, *Oliver in Trans. Linn. Soc.* xxix. (1875) 130.
Mutshukwana, Lower Buzi, 400 ft.; in fl. Dec.; n. 1934.
Distrib. Abyssinia to Amboland and Rhodesia.

ADHATODA BAGSHAWEI, *S. Moore in Journ. Bot.* xlv. (1907) 333.
Chirinda Forest, 3700–4000 ft.; in fl. & fr. Oct.; nn. 127, 127 *a*.
Distrib. Uganda.

ISOGLOSSA MOSSAMBICENSIS, *Lindau in Engl. Pflanzenw. Ost-Afr.* C. 372 (ex descript.).
Chirinda Forest, 3700–4000 ft.; in fl. May; nn. 248 *a*, 1146.
Distrib. Mozambique.
A very tall herb forming thickets in some portions of the forest.
There are some small differences between Lindau's description and the specimens here dealt with: the bracts of the upper flower of every spikelet are not ovate but spathulate, the lips of the corolla are rather shorter, and the anthers, in *I. mossambicensis* 2·5 mm. long., here do not exceed 1·5–2 mm.; the former measurement being that of the lower, the latter that of the upper anther of each stamen.

HYPOESTES ARISTATA, *R. Br. Prod.* 474.
Near Chirinda, 3800 ft.; in fl. May; n. 105.
Distrib. Tropical East Africa and South Africa.

H. VERTICILLARIS, *R. Br. Prod.* 474.
Upper Buzi at 3000 ft.; Upper Jihu at 3300 ft.; in fl. April, July; nn. 1932, 1933.
Distrib. Tropical and South Africa, and Arabia.

Macrorungia pubinervis, *C. B. Clarke in Fl. Trop. Afr.* v. 255.

Chirinda Forest, 3700–4000 ft.; in fl. May, Oct.; nn. 77, 77 *a*.

Distrib. Nyasaland, German East Africa.

The commonest shrub of the undergrowth. Crimson flowers, very attractive to two species of sunbirds (*Cinnyris olivacina* and *Anthothreptes zambesiana*).

Rhinacanthus communis, *Nees in Wall. Plant. Asiat. Rar.* iii. 109.

Lower Umswirizwi River, 1000 ft.; in fl. Nov.; n. 2131.

Distrib. Tropical and South Africa, Mascarene Islands, Tropical Asia.

Dicliptera cephalantha, *S. Moore*, sp. nov.

Herba caule sat elato ascendente gracili inferne ramoso tetragono pilis albidis hispidulo, foliis subsessilibus breviter petiolatis oblongo-linearibus apice pungentibus basi obtusis utrinque pilis appressis puberulis, spiculis 2-floris in glomerulum oblongum vel oblongo-ovoideum quam folia breviorem congestis, bracteis lineari-subulatis longe spinuloso-acuminatis dorso scabridis et glandulosis margine longe ciliatis sursum vero ciliolatis subcoriaceis in sicco viridibus, bracteis interioribus anguste lineari-lanceolatis longe spinuloso-acuminatis piloso-pubescentibus margine usque ad medium ciliatis, calycis lobis quam bracteæ interiores paullo brevioribus linearibus superne longe acuminatis margine ciliatis, corollæ mediocris tubo faucibus parum dilatato limbo æquilongo extus piloso-puberulo, filamentis exsertis, capsula ima basi contracta anguste ovoideo-oblonga puberula.

Hab. Cultivated ground near Chirinda at 3800 ft.; in fl. May; n. 514.

Folia 2–4·5 × 0·4–0·5 cm., firme membranacea, in sicco fusco-olivacea; petioli sæpissime 2 mm., raro 5 mm. long. Glomeruli rite evoluti 3–3·5 × 1·5–2 cm. Bracteæ sæpissime circa 5 mm. long. Bracteola externa altera 8–10 mm. long., altera 6–8 mm.; internæ 5–6 mm. Flores dilutissime purpurei. Corollæ tubus 6·5 mm. long., inferne 1·5 mm., juxta medium 1 mm., faucibus 2 mm. diam.; labium posticum late obovatum, integrum; anticum obovatum, breviter 3-dentatum. Filamenta puberula, fere 9 mm. long.; antherarum loculi quadrati, 0·75 mm. diam. Ovarium circa 1 mm., stylus exsertus et glaber, 1·5 cm. long. Capsula 6 mm. long., 4-sperma. Semina lævia, humectata 1·5 × 2 mm.

Differs from *D. Carvalhoi*, Lindau, among other features, in the narrow subsessile leaves, and the aggregated spikelets with shorter and relatively broader outer bracteoles.

The second flower of all the spikelets opened was more or less rudimentary

Dicliptera extenta, *S. Moore*, sp. nov.

Herba caule gracili superne folioso puberulo, foliis lanceolato-oblongis ellipticisve obtusis basi in petiolum tenuem sat longum gradatim angustatis

tenuiter membranaceis cito fere omnimodo glabris, spiculis 3-floris longipedunculatis paucis ex axillis superioribus ortis inter se satis distantibus, bracteis exterioribus 0 interioribus imparibus obovatis sursum rotundatissimis apice ipso subito breviterque spinuloso-acuminatis margine sparsim ciliatis ceteroquin glabris in sicco læte viridibus, bracteolis calyce longioribus angustissime lineari-lanceolatis acutis, calycis minute pubescentis lobis tubum plane excedentibus angustissime lineari-lanceolatis acutis, corollæ tubo superne levissime dilatato limbo tubum breviter excedente labio antico late oblongo trilobo lobo intermedio quam laterales multo majore lobis postico oblongo-obovato integro, filamentis labium fere æquantibus antherarum loculis superpositis muticis.

Hab. Mt. Maruma, 3500 ft. ; in fl. Sept. ; n. 1937.

Folia petiolo exempto 5–6 cm. long., 1·8–2·5 cm. lat. ; petioli 1·2–2·25 cm. long. Folia floralia lineari-subulata, patentia, 4–6 mm. long. Spicularum pedunculi rite evoluti 2–4·5 cm. long. ; pedicelli aliquantulum divergentes, 5–15 mm. long. Bractea altera 16 × 9 mm., altera 12 × 7 mm., ambæ eleganter nervosæ, basin versus aliquanto decolores. Bracteolæ circa 9 mm. long. Calycis tubus 1·5 mm., lobi piloso-ciliati 5·5 mm. long. Flores albi purpureo-tincti. Corollæ tubus 1 cm. long. ; labium anticum 1·3 cm., posticum 1·2 cm. long. Filamenta ad 1 cm. ex tubo eminentia ; antherarum loculi oblongo-ovoidei, 1·25 mm. long. Ovarium 1·7 mm., stylus 2 cm. long.

Easily distinguished from *D. maculata*, Nees, by the more effuse spikelets and the obovate bracts.

DICLIPTERA SWYNNERTONII, *S. Moore*, sp. nov.

Herba ramosa, ascendens, caule sat attenuato in nodis aliquanto tumido subtiliter pubescente dein puberulo, foliis comparate elongatis anguste lineari-lanceolatis lineari-oblongisve obtusis basi in petiolum sæpissime brevem leviter attenuatis firme membranaceis utrinque costa centrali appresse strigillosa exempta fere glabris, spiculis 1–2-floris in axillis subcongestis, bracteis exterioribus sæpissime subulatis acuminatis rigidiusculis interioribus majusculis late ovatis spinuloso-acuminatis utrobique piloso-pubescentibus margine usque ad basin ciliatis membranaceis in sicco saturate dilutiusve viridibus, bracteolis parvulis lineari-subulatis acuminatis, calycis puberuli bracteolas paullulum excedentis lobis lineari-setaceis acutis tubum duplo excedentibus, corollæ tubo superne parum dilatato limbo quam tubus paullo breviore extus puberulo, filamentis exsertis.

Hab. Chirinda Forest, 3700–4000 ft. ; in fl. May, June, July ; nn. 528, 528 *a*, 528 *b*.

Folia exemplarium aliorum 6–8·5 cm. long., et modo 5–8 (rare 10) mm. lat., aliorum 3–5 cm. × 6–8 mm., omnium margines repandæ vel fere integerrimæ, in sicco vive viridia ; petioli sæpissime 3–5 mm. long., raro adusque 2 cm. Pedicelli pubescentes. Bracteæ exteriores ± 4 mm. long.; interiores

inæquales, 8–12 mm. long., 6–8 mm. lat. Bracteolæ circa 2 mm. long. Flores punicei. Calyx 3 mm. long.; lobi 2 mm. long. Corolla in toto 1·3 cm. long.; tubus 8 mm. long., basi 0·8 mm. superne 1·2 mm. lat.; labium posticum obovatum, integrum, antico obovato-oblongo tridentato æquilongum. Filamenta glabra, 6 mm. long.; antherarum loculi oblongo-ovoidei, 1 mm. long. Ovarium 1 mm., stylus 1·25 cm. long.

The affinity is with *D. heterostegia*, Presl, from which it can easily be recognised by the more hairy bracts, the small bracteoles, calyx and corolla, and especially by the narrow leaves usually borne on short petioles. Even when the petioles are larger, the blade always ends acutely, never being broadly rounded as is the case with *D. heterostegia.*

Dicliptera nobilis, *S. Moore,* sp. nov.

Herba elata caule erecto superne ramuloso quadrangulari minute puberulo, foliis longipetiolatis ovatis apicem versus attenuatis apice obtuse acutis basi rotundatis membranaceis utrobique præsertim ad costas puberulis, spiculis 2-floris in axillis approximatis vel caulis ramulorumve apicibus insidentibus, pedicellis quam bracteæ multo brevioribus, bracteis exterioribus lineari-subulatis longe acuminatis bracteas interiores semiæquantibus, bracteis interioribus inter se inæqualibus ovatis utrinque sed præcipue apicem versus attenuatis breviter spinuloso-acuminatis puberulis margine piloso-ciliatis, bracteolis calyces excedentibus oblongo-oblanceolatis longe acuminatis, calycis puberuli lobis inter se imparibus angustissime lineari-lanceolatis acuminatis, corollæ magnæ extus puberulæ tubo sursum levissime amplificato limbo tubum excedente labio antico lineari-oblongo subæqualiter tridentato labio postico anticum paullulum excedente ovato-oblongo integro, filamentis labio antico subæquialtis, antherarum loculis superpositis muticis.

Hab. Near Chirinda, 3500 ft.; Melsetter, 6000 ft.; in fl. June, Sept.; nn. 1935, 1936.

Folia 6–10 × 3–4·3 cm., petiolo puberulo 1·5–2·2 cm. long. exempto, sæpe vero exstant minora, sc. 3–3·5 × 1–1·3 cm. petiolo circiter 5 mm. long. fulta. Bracteæ exteriores adusque 7 mm. long.; interiores 13–15 × 6–8 mm. Bracteolæ cymbiformes, fusco-uninerves, longitudine 1 cm. paullulum excedentes. Flores vivide purpurei. Calycis tubus vix 2 mm. long.; lobi 5·5 mm. Corolla 2·9–3·1 cm. long., tubus 1·3 cm., basi 2·5 mm., faucibus 3·5 mm. lat.; labium anticum 14–16 × 3 mm.; posticum 16–18 × 7 mm., illius dentes 1 mm. long. Filamenta 1·5 cm. long., antherarum loculi subquadrati 1 mm. Stylus puberulus, 2·5 cm. long.

Near *D. Clinopodia*, Nees, and *D. Leonotis*, Dalz. Differing on sight from both in the broad leaves with rotund base, the broad bracts, and long corollas.

SELAGINEÆ.

HEBENSTREITIA DENTATA, *Linn. Sp. Pl.* 629.
Nyahodi River, at 5000 ft.; in fl. April; n. 1888.
Distrib. Abyssinia to Angola and Nyasaland; also South Africa.

H. ELONGATA, *Bolus ex Rolfe in Fl. Cap.* v. Sect. 1, 99.
Mt. Pene, 6500–7000 ft.; in fl. Sept.; n. 1887.
Distrib. Natal and Transvaal.
Not hitherto reported as a tropical plant.

WALAFRIDA SWYNNERTONII, *S. Moore*, sp. nov.

Perennis, ultraspithamea, caulibus erectis tenuibus ut ramuli foliaque minute scabriusculo-pubescentibus demum glabris vel fere glabris, ramulis ascendentibus tenuibus crebro foliosis, foliis nunc alternis nunc fasciculatis anguste linearibus obtusis, spicis abbreviatis ovatis paucifloris in paniculas sublaxas ramulos terminantes dispositis, bracteis cymbiformibus ovato-oblongis obtusis, calycis ad medium usque divisi segmentis 3 inter se subæqualibus lineari-oblongis obtusiusculis ut bracteæ margine ciliatis necnon dorso minute hispidulis, corollæ tubo bracteam plane excedente superne leviter amplificato inferne minutissime puberulo limbo subæqualiter 5-lobo (lobis posticis quam ceteri paullo minoribus) lobis tubo brevioribus ovato-oblongis obtusis, staminibus 2 juxta medium tubum 2 sub faucibus insertis, fructibus subreniformibus in coccos 2 secedentibus.

Hab. Nyahodi River, 5000 ft.; in fl. & fr. April; n. 2135.

Folia 3–5 mm. long., circa 0·3 mm. lat. Spicæ circa 5 × 4 mm. Bracteæ 2 mm. long. Flores albi. Calyx 1·75 mm. long.; hujus lobi circiter 0·8 mm. long. Corollæ tubus vix 3 mm. long., deorsum 0·75 mm. sursum 1 mm. diam.; lobi postici 0·75 mm., ceteri 1 mm. long. Stamina superiora breviter exserta, inferiora inclusa, illorum filamenta 1 mm. horum 0·75 mm. long. Stylus pilosus, vix 4 mm. long. Fructus 1·2 × 1·2 mm.; pericarpium crustaceum.

This has much the appearance of *W. paniculata*, Rolfe, but its flowers are very different.

VERBENACEÆ.

LANTANA SALVIFOLIA, *Jacq. Hort. Schœnb.* iii. 18.
Melsetter 6000 ft.; Chirinda 3700–4000 ft.; fl. April, Dec.; nn. 259, 1161, 2002.
Distrib. Tropical and South Africa, East Indies.
Chindao name, "Mushani."

LIPPIA WILMSII, *H. H. W. Pears. in Fl. Cap.* v. pt. 1, 196.
Near Chirinda; in fl. May, Dec.; nn. 258, 474.
Distrib. Transvaal and Tropical East Africa.

Lippia asperifolia, *Rich. Cat. Hort. Med. Paris.* 67.

Near Chirinda 3800 ft.; Melsetter 6000 ft.; in fl. April, May, Dec.; nn. 260, 475, 475 *a*, 1160, 2003.

Distrib. Tropical and South Africa; also in Tropical America.

The Chindao name of the Lippias is also "Mushani," that of *L. asperifolia* being "Mushani omkulu" (=large *Lippia*). The leaves of all the Mushanis are used as a remedy for indigestion, being chewed or ground, mixed with water and drunk by the natives. They are also used as a disinfectant after the handling of infected or decaying substances.

Bouchea Wilmsii, *Gürke in Notizbl. K. bot. Gart. Berlin*, iii. (1900) 74.

Lower Umswirizwi River, 1000 ft.; in. fl. Nov.; n. 1938.

Distrib. Transvaal.

Of this, now first recorded as tropical, there is another tropical specimen at the British Museum from Bulawayo; *E. C. Chubb*, 102.

Priva leptostachya, *Juss. in Ann. Mus. Paris*, vii. (1806) 70.

Near Chirinda, 3800 ft.; in fl. May, June; nn. 269, 517.

Distrib. Tropical East Africa, East Indies.

Premna serratifolia, *Linn. Mant.* ii. 253.

Beira beach; in fl. Dec.; n. 1943.

Distrib. Tropical East Africa, Mascarene Islands, East Indies.

Clerodendron (§ Siphonanthus) Swynnertonii, *S. Moore*, sp. nov.

Frutex scandens ramulis ultimis foliosis puberulis mox glabris, foliis petiolatis oblongo-ovatis vel obovato-oblongis sæpius cuspidato-acuminatis apice mucronulatis basi rotundatis levissimeve cordatis tenuiter membranaceis utrinsecus glabris basi trinervibus costis secundariis utrinque 3–4 apertissime arcuatis, floribus majusculis in cymas pseudoterminales pedunculatas subcongestas paucifloras dispositis, bracteis obovatis obtusis vel acutis pedicellos excedentibus, calyce campanulato usque ad medium diviso glabro lobis ovatis subito acutatis, corollæ puberulæ tubo calycem 6-plo excedente ipsis sub faucibus dilatato lobis inter se subæqualibus ovato-oblongis obtusis, staminibus longe exsertis, drupa obovoidea leviter 4-loba exocarpio succoso tenui endocarpio crustaceo.

Hab. Common in the Chirinda Forest, 3700–4000 ft.; in fl. & fr. May; n. 85.

Folia solemniter 8–12 cm. long., 4–5·5 (rarius 6) cm. lat., in sicco læte-virentia, utrinque nitida; petioli tenues, puberuli, sæpissime 1–2 cm. long. Cymarum pedunculi 1–2 cm. long., puberuli; pedicelli circa 3–4 mm., bractea 5–7 mm. long. Flores albi. Calyx in sicco virescens 8 mm. long., humectatus totidem lat. Corollæ tubus 5 cm. long, fere 1–5 mm. lat., sub faucibus vix 3 mm.; lobi 8·5 mm. long., 4·5–5 mm. lat. Antheræ ovoideæ, 2·5 mm. long. Stylus 7 cm. long. Drupa nigra, 1 cm. long.

Known by the leaves and the few-flowered cymes, and among neighbouring species by the small calyces.

CLERODENDRON MYRICOIDES, *R. Br. in Salt. Abyss., App.* lxv.

Near Chirinda 3500 ft.; Mt. Umtereni 4000 ft.; Mt. Pene 7000 ft.; Haroni River at 5000 ft.; Kurumadzi River 2000 ft.; Madanda forests at about 400 ft.; in fl. Sept.–Dec.; nn. 173, 1295, 1296, 1297, 2005, 6089.

Distrib. Tropical Africa, Natal, Transvaal.

CLERODENDRON (§ Cyclonema) AMPLIFOLIUM, *S. Moore*, sp. nov.

Frutex elatus ramis sursum foliosis compressiusculis dense ac subtiliter pubescentibus deinde subteretibus et cortice dilute brunneo glabro obductis, foliis oppositis amplis ovatis cuspidato-acuminatis apice mucronatis basi rotundatis in petiolum manifestum subito angustatis margine satis grosse serrato-crenatis crassiusculo-membranaceis utrinsecus in nervis pubescentibus alibi puberulis, floribus pro rata majusculis in cymas pedunculatas laxas plurifloras pubescentes digestis, bracteis linearibus vel lineari-oblongis obtusiusculis puberulis, pedicellis calycem æquantibus vel excedentibus puberulis, calyce campanulato ad medium usque diviso lobis ovato-oblongis obtusis intus minutissime lepidotis, corollæ tubo lato quam calyx fere duplo longiore faucibus levissime contracto limbi lobis anguste obovato-oblongis obtusissimis tubum leviter excedentibus, staminibus longe exsertis.

Hab. Chirinda Forest, 3700–4000 ft.; in fl. April; n. 335.

Foliorum lamina apicem versus integra, 12–15 cm. long., juxta medium 7–8 cm. lat. (speciminis alterius 9–11 × 6·7 cm.), paullo supra basin vix 1 cm. metiens, ima basi modo 5 mm., in sicco aliquanto olivacea subtus griseola; costæ secundariæ utrinque circa 8, inferiores patulæ, amplissime arcuatæ superiores ascendentes; crenellæ 1–1·5 mm. alt., 4–8 (raro 11) mm. long.; petioli lati, pubescentes, ± 1 cm. long. Cyma corollis exemptis adusque 8 cm. long.; pedunculus 4·5 cm. long.; bracteæ ± 8 mm. long., verisimiliter purpureæ. Pedicelli 5–25 mm. long., prope medium bracteolis 2 parvis linearibus onusti. Calyx 7·5 mm. long., tubus 4 mm., lobi 3·5 × ± 3 mm. Corollæ tubus 11 mm. long., ima basi 3·5 mm., paullo supra basin 5 mm., faucibus 4 mm. lat.; lobi 12–14 mm. long., 5–6·5 mm. lat. Filamenta inferne glanduloso-villosula, fere 3 cm. ex tubo eminentia; antheræ oblongæ, 2 mm. long. Ovarium ovoideum, 3 mm. long. Stylus circa 3·5 cm. long.; stigmatis rami inter se inæquales, alter 2 mm. alter 2·5 mm. long.

Allied to *C. myricoides*, R. Br., but different from all the recently described species with this affinity. The large, very broad crenate leaves enable one to distinguish it on sight.

C. LANCEOLATUM, *Gürke in Engl. Bot. Jahrb.* xviii. (1893) 181.

Hargwe River, Jihu, 2000 ft.; in fl. Jan.; n. 315.

Distrib. Tropical East Africa.

Clerodendron hirsutum, *H. H. W. Pears. in Fl. Cap.* v. pt. i. 221.
Chimanimani Mts. at 7000 ft.; Mt. Pene 7000 ft.; in fl. Sept., Oct.; nn. 2004, 6086.
Distrib. South Africa.

Vitex Buchanani, *Bak. ex Gürke in Engl. Pflanzenw. Ost-Afr.* C. 339.
Boka to Umhlonhlo, Lower Buzi, 100 ft.; in fl. Dec.; n. 1053.
Distrib. Nyasaland.

V. Eylesii, *S. Moore, in Journ. Bot.* xlv. (1907) 154.
Near Chirinda 3500 ft.; Madanda forests at about 400 ft.; Chikore Hills 3500 ft.; Kurumadzi River 2000 ft.; in fl. April, Nov., Dec.; in. fr. May, June; nn. 34, 34 *b*, 1059, 1060, 1061.
Distrib. Rhodesia.
Singuni name, "Umbindoio"; Chindao name, "Mukubvu." A smallish tree with black edible fruit. Leaves dried, pulverized and scorched are used by natives as a snuff in cases of sore throat or cold in the head.

V. Cienkowskii, *Kot. & Peyr. Pl. Tinn.* 27, t. 12.
Kurumadzi River; in fl. Nov.; n. 1058.
Distrib. Tropical Africa.
Singuni name, "Umbindoio."

Vitex Swynnertonii, *S. Moore*, sp. nov.
Frutex grandis, ramis sæpe prostratis ramulis sursum foliatis fulvo-pubescentibus deinde glabrescentibus, foliis oppositis longe graciliterque petiolatis sæpissime 5-foliolatis foliolis mediocribus vel parvis anguste ovato-oblongis vel oblongo-obovatis apice rotundatis vel obtusis ipso pulvinatis vel barbatis basi in petiolum manifestum cuneatim angustatis margine integris leviterve undulatis tenuiter membranaceis supra glabris subtus pubescentibus, cymis axillaribus brevibus pedunculatis paucifloris fulvo-sericeis, bracteis linearibus vel lineari-oblongis pedicellos excedentibus, calycis campanulati dense fulvo-sericei lobis deltoideis acutis vel obtusis quam tubus plane brevioribus, corollæ extus pubescentis tubo calycem duplo superante superne incurvo leviterque ampliato lobis posticis abbreviatis ovatis obtusis lateralibus latissime ovato-oblongis obtusissimis quam anticus paullo brevioribus, antheris breviter exsertis harum loculis subparallelis.
Hab. Madanda forests at about 400 ft.; in fl. Dec.; n. 1054.
Foliola modice 2·5–6 cm. long., 1–3 cm. lat., basalia quam cetera sæpe multo minora, pagina superiore in sicco olivaceo-castanea, pagina inferiore griseo-brunnea; petiolus ad 6·5 cm. usque, sæpe vero brevior; foliorum basalium petioluli circa 2 mm. long., folioli terminalis ± 7 mm.; costæ

secundariæ utrinque circa 10, parum aspectabiles. Cymæ circa 1·5 × 1·5–2 cm. Pedunculi 1 cm. long. vel minus. Bracteæ pubescentes, ± 4 mm. long. Pedicelli 1–2 mm. long. Flores albi. Calyx 3 mm. long., lobi vix 1 mm. Corollæ tubus 6 mm. long., ima basi 2·2 mm., ore 4·2 mm. lat.; lobi postici 2·5 mm. long., laterales 4 mm., anticus ægre 5 mm. long. Stamina summum 2·5 mm. ex tubo corollæ eminentia; antheræ 0·8 mm. long. Ovarium superne attenuatum setosumque, 2·5 mm. long.; stylus glaber, 6·5 mm. long. Bacca ignota.

Near *V. Welwitschii*, Gürke, from which it can be distinguished on sight by its differently shaped leaflets on longer petiolules.

VITEX DRYADUM, *S. Moore*, sp. nov.

Frutex grandis, ramis sæpe prostratis ramulis deorsum nudis fulvo-pubescentibus dein glabrescentibus, foliis petiolis longis gracilibus breviter pubescentibus insidentibus sæpissime 5-foliolis foliolis sat longe petiolulatis lanceolatis vel lanceolato- vel oblanceolato-oblongis caudato-acuminatis basin versus angustatis basi obtusis vel acutis margine ad medium integris abhinc serrato-crenatis tenuiter membranaceis supra glabris subtus præsertim in costis costulisque puberulis, cymis axillaribus abbreviatis pedunculatis pauci-floris fulvo-sericeis, bracteis linearibus pedicellos excedentibus, calyce campanulato fulvo-sericeo quam lobi triangulares obtusi longiore, corollæ tubo extus puberulo calycem bene excedente superne amplificato juxta medium valde curvato lobis extus fulvo-pubescentibus posticis lateralibusque ovatis obtusissimis his quam illi duplo longioribus lobo antico magno subquadrato patentissimo, staminibus exsertis antheris subparallelis.

Hab. Open woods at Beira; in fl. Dec.; n. 1062.

Ramuli nudi circa 2 mm. diam., ad nodos cicatricosi. Foliorum petioli 5·5–7·5 cm. long.; foliola basalia solemniter 2–3 cm. long., 1·2–1·5 cm. lat., folium terminale 8–11 × 2·5–3·5 cm., foliola in sicco pagina superiore olivacea pagina inferiore griseo-viridia; costæ secundariæ utrinque 9–12, ut reticulum delicatulum faciliter aspectabiles; foliorum basalium petioluli 2–4 mm. long., foliorum intermediorum 4–10 mm., folii terminalis 1·5–2 cm. long. Cymæ circa 2 × 1·5 cm. Pedunculi circa 1 cm. long., bracteæ ± 4 mm., pedicelli 1·2 mm. Calyx 3 mm. long., lobi ægre 1 mm. Corollæ tubus 8 mm. long., basi fere 2 mm., ore vix 5 mm. lat.; lobi postici 3 mm. long., laterales 5 mm., anticus 7 mm. Stamina longiora 4 mm. ex tubo corollæ eminentia; antheræ 0·5 mm. long. Ovarium ovideum, setosum, vix 2 mm. long. Stylus glaber, 1 cm. long., sub stigmate leviter incrassatus. Baccæ non suppetunt.

Differs from the last in the shape and toothing of the leaflets, and in several floral details.

LABIATÆ.

The collection includes *Leucas martinicensis*, R. Br., a tropical weed.

OCIMUM SUAVE, *Willd. Enum. Hort. Berol.* 629.

Near Chirinda Forest, 3700–4000 ft.; in fl. Aug.; nn. 384, 466.

Distrib. Tropical Africa and Asia.

O. KNYANUM, *Vatke, in Linnæa*, xxxvii. (1871–73) 315.

A common herb in the grass-veld and in cultivated ground near Chirinda; Southern Melsetter, 2000–3500 ft.; in fl. Feb., May, Nov.; nn. 277, 468, 1988.

Distrib. Tropical Africa.

OCIMUM (§ Hierocimum) ODONTOSEPALUM, *S. Moore*, sp. nov.

Humile (semispithameum) caule erecto ramulos perpaucos juxta solum gignente aliter simplici griseo-piloso pubescente, foliis paucis præcipue ramulorum apicem versus confertis oblongis vel anguste oblongo-obovatis obtusis margine crenatis crenulatisve dense hirsutulo-pubescentibus, spicastris rite evolutis folia longe excedentibus pilis retrorsis pubescentibus, verticillastris demum sat distantibus vulgo 4–6-floris basi glandulis duabus poculiformibus perspicuis instructis, floribus pro rata majusculis pedicellatis, bracteis parvulis ovatis obtusis fugaceis, calycis sub anthesi campanulati sparsim piloso-pubescentis lobo postico decurrente suborbiculari margine obscure denticulato purpureo lobis lateralibus magnis rotundato-quadratis margine pluridentatis dentibus acuminatis lobis anticis triangulari-subulatis quam laterales brevioribus, corollæ glanduloso-puberulæ tubo calyce plane longiore superne ampliato labio antico obovato quam posticus paullo longiore, filamentis longe exsertis.

Hab. Melsetter, 6000 ft.; in fl. Oct.; nn. 6087, 6088.

Folia 1–2 cm. long., 4–6 mm. lat. Spicastra tandem fere 10 cm. long. Verticillastra distantia inter se summum 2 cm. Bracteæ circa 2·5 mm. long., extus pilosulæ. Pedicelli 1·2 mm. long. Calyx sub anthesi 5–6 mm. long.; lobus posticus 4 mm. long., vix totidem lat.; lobi laterales $4 \times 3{\cdot}5$ mm., lobi antici 2·5 mm. long. Calyx fructescens 8 mm. long., 5 mm. lat.; hirtulo-puberulus, eleganter nervosus, subnitidus. Corollæ tubus fere 1 cm. long., basi 2 mm. ore 7 mm. lat.; labium anticum 6 mm. long.; labii postici 5 mm. long., lobi laterales oblongo-ovati, obtusissimi, 2 mm. long., lobi antici 2 mm. long., suborbiculares, margine crispuli. Filamenta circa 1·5 cm. ex corolla eminentia.

This can at once be distinguished by the large toothed lateral lobes of the calyx.

ACROCEPHALUS CALLIANTHUS, *Briq. in Engl. Bot. Jahrb.* xix. (1894) 169.

Lusitu River at 5000 ft.; in fl. April; n. 1955.

Distrib. Mozambique and Nyasaland.

ACROCEPHALUS (§ Holochili) CHIRINDENSIS, *S. Moore*, sp. nov.

Herbaceus, perennis, caule stricto sursum ramoso fere omnimodo folioso griseo-pubescente dein puberulo, foliis anguste oblongo- vel lineari-lanceolatis basi apiceque obtusis sessilibus brevissimeve petiolatis margine integris vel subevanide denticulatis firme membranaceis pagina superiore fere glabris inferiore pilis strigillosis appressis præcipue ad costas costulasque onustis foliis summis in bracteas transeuntibus apicem versus sæpissime coloratis, capitulis parvis globosis pedunculis pubescentibus insidentibus in cymas breves oligocephales caulem ramulosque summos coronantes dispositis, bracteis late ovatis sursum attenuatis apice obtusiusculis extus breviter appresse strigillosis sursum cyaneis, calycis tubo hirsuto labio postico subrotundo quam anticum leviter retusum manifeste latiore, corollæ tubo calycem excedente dimidio superiore ampliato labii postici lobo intermedio obovato bifido lobis lateralibus oblongis obtusis lobis antico ovato-oblongo obtuso posticum æquante, stylo sat longe exserto crassiusculo.

Hab. Near Chirinda and near the source of the Hargwe river, Jihu ; in fl. April, May ; nn. 313, 379, 501.

Folia solemniter 3–5 cm. long., 6–13 mm. lat., summa in bracteas transeuntia ±8 mm. long. Bracteæ exteriores ±7 mm. long., interiores circa 5 mm. long., basi 4 mm. lat. Flores albi, atropurpureotincti. Calycis tubus 0·75 mm. long. ; labium anticum 0·8 mm., posticum 1 mm. long. Corollæ tubus 2·2 cm. ex calyce eminens, inferne 0·6 mm., superne 1·25 mm. lat. ; labii postici lobi laterales 1·5 mm. long., lobus intermedius 1·8 × 1·5 mm. ; labium anticum 1·8 mm. long. Stylus 6·5 mm. long., stigmatis rami 0·3 mm.

This looks much like *A. minor*, Briq., which has green bracts, a smaller calyx and corolla and a different lower lip.

ACROCEPHALUS (§ Holochili) PICTURATUS, *S. Moore*, sp. nov.

Suffrutex, caule gracili dissite folioso hispidulo-piloso, foliis oblongo-lanceolatis raro lanceolato-ovatis acutis basin versus integris et in petiolum manifestum coartatis alibi serrulato-crenulatis rarius serrato-crenatis membranaceis utrobique pilis sparsis strigillosis appressis onustis, capitulis parvis globosis ad apicem ramulorum corymbum brevem tricephalum referentibus, bracteis exterioribus sæpe elongatis lineari-lanceolatis acutis margine crenulatis subintegrisve appresse strigilloso-puberulis basi albis nonnunquam dilutissime cæruleis ceterum viridibus, bracteis interioribus flores amplectantibus ovato-rotundatis acutis, calycis florescentis hirsutulo-pilosi labiis integris rotundatis postico quam anticum plane longiore, corollæ tubo calycem excedente superne gradatim dilatato labii postici trilobi lobis ovatis lateralibus obtusis intermedio integro obtusissimo, labio antico ovato-oblongo quam posticum longiore.

Hab. Common in good soil near Chirinda ; n. 257.

Folia solemniter 6–8 cm. long., 1·7–2 cm. lat. (raro 2·5 cm.), in sicco viridia,

pagina inferiore pallidius colorata ; ordinis secundi costæ utrinque circa 10, mediocriter prominulæ ; serrulæ modice 0·5–1 mm. alt., 1–2·5 mm. (raro ad 3·5 mm. usque) long. ; petioli ±1 cm. long., piloso-hispiduli. Corymbi griseo-raro cæruleo-pubescentes, 1·5–2·5 x 2–4 cm. Capitula humectata 6·5–9 mm. diam. Bracteæ exteriores longiores 3·5–4 cm. long., breviores 1·5–2 cm., illæ fere 10 mm. lat., hæ ±6 mm. Bracteæ interiores dorso hispidulo-pilosæ, modice circa 5 x 4·5 mm. Calyx florescens fere 2 mm. long. ; labium posticum 1·25 mm., anticum 0·35 mm. long. Calyx fructescens 4–5 mm. long. Corollæ tubus 3 mm. long. ; basi 0·6 mm. faucibus 1·2 mm. lat. ; labii postici lobi 1·25 mm. long., labium anticum 1·5 mm. Stylus 4 mm. ex tubo corollæ eminens. Nuculæ cylindricæ, dilute brunneæ, 1 x 0·5 mm.

To be inserted in the genus next *A. Poggeanus*, Briq., from which it is easily distinguished by the inflorescence, the long outer bracts, and smaller flowers.

Orthosiphon Woodii, *Gürke in Engl. Bot. Jahrb.* xxvi. (1898) 83.

Mt. Pene, 6500–7000 ft. ; in fl. Sept. ; n. 1974.

Distrib. Zululand. Now first announced as a tropical plant.

Hemizygia (§ Pseudocimum) ornata, *S. Moore*, sp. nov.

Herba cæspitosa circa spithamea caule ascendente a basi folioso piloso-hirtulo ramulos perpaucos breves teneres emittente, foliis pro rata parvis ovatis (summis ovato-oblongis) apice obtuse mucronatis basi obtusissimis vel in petiolum subnullum leviter angustatis margine denticulatis basin versus integris firme membranaceis utrinque præsertim in costis hirtulo-puberulis, spicastris simplicibus folia excedentibus piloso-pubescentibus e verticillastris pluribus 4–8-floris compositis, bracteis superioribus majusculis ovato-lanceolatis acuminatis apice ipso obtusis minute puberulis coloratis, floribus mediocribus brevipedicellatis, calycis sub anthesi dense piloso-pubescentis tubo cylindrico lobos plane excedente lobo postico rotundato-ovato obtuso quam ceteri setiformes subæquilongo, corollæ extus sparsim puberulæ tubo ex calyce breviter eminente labii postici lobo intermedio suborbiculare lobis lateralibus late ovatis obtusissimis labio antico postico vix æquilongo cymbiformi apice obtusiusculo, staminum anticorum filamentis sat alte coalitis, stigmate emarginato.

Hab. Mt. Pene, 6500–7000 ft. ; in fl. Sept., Oct. ; nn. 1999, 6078.

Folia profecto evoluta 2·5 x 1·5 cm., summa perpauca usque ad 15 x 7 mm. redacta, in sicco pulchre viridia ; ordinis secundi costæ utrinque 4–5, leviter arcuatæ, costularum reticulum laxum utrobique aspectabile ; petioli dum adsint modo 1–2 mm. long. Spicastrum speciminis magis maturi nobis obvii 8 cm. long. Bracteæ superiores saltem 14 mm. long., ad medium 7 mm. lat., vivide puniceæ. Pedicelli circa 2 mm. long. Calyx sub anthesi totus 7·5 mm. long. ; tubus 5 x 2 mm.; lobus posticus 2·5 x 2·5 mm.; lobi laterales 2·5 mm., antici vix 3 mm. long. Calyces fructescentes non suppetunt. Corollæ tubus

calycem 3 mm. excedens, fauces ampliati 4 mm. diam.; labii postici lobus intermedius 2·5 × 2·5 mm.; lobi laterales 2 mm. long., basi ægre 3 mm. lat.; labium anticum 4·25 mm. long. Staminum anteriorum filamenta usque ad 3 mm. ab apice coalita.

Among the species with large foliaceous bracts this is known at once by the small ovate leaves.

Mr. Swynnerton notes this as a low herb with bright pink bracts growing in large clumps amongst the short grass on the hill-tops, and making a great show.

HEMIZYGIA BRACTEOSA, *Briq. in Ann. Conserv. & Jard. Bot. Genève*, 1898, 248.

Chikore Hills 3500 ft.; Umvumvumvu River at 4000 ft.; Lower Buzi up to 400 ft.; in fl. March, April, Dec.; nn. 268, 1956, 1957.

Distrib. Senegambia to Nyasaland.

H. TEUCRIIFOLIA, *Briq. in Engl. & Prantl, Pflanzenfam.* iv. 3 A, 369.

Mt. Pene, 7000 ft.; in fl. Oct.; n. 6075.

Distrib. South Africa.

Another addition to the tropical flora.

HEMIZYGIA (§ Eu-Hemizygia) FLABELLIFOLIA, *S. Moore*, sp. nov.

Fruticosa ramulis sat validis crebro foliosis arcte argyreo-tomentosis tandem glabrescentibus, foliis pro rata parvis brevipetiolatis late obovatis obtusissimis basi gradatim cuneatis margine triente abaxiali serrato-crenulatis ceteroquin integris pergamaceis utrinsecus arcte argyreo-tomentosis secundi ordinis costis utrinque 4 basi aliquanto approximatis inde flabellatim divergentibus, spicastris folia haud multo superantibus simplicibus, verticillastris approximatis 3–4-floris, bracteis parvis suborbicularibus caducissimis, calycis sub anthesi cylindrico-campanulati densissime griseo-pubescentis tubo lobos excedente lobo postico magno suborbiculari quam lobi reliqui inter se subæquales lanceolati vel deltoideo-lanceolati acuminati longiore, corollæ tubo calycem excedente superne gradatim amplificato extus griseo-puberulo labii postici lobo intermedio late obovato emarginato quam lobi laterales abbreviati multo majore labio antico postico subæquilongo suborbiculari labiis ambobus extus minute griseo-pubescentibus, staminum anticorum filamentis alte connatis, stigmate bifido.

Hab. In crags among the Chimanimani mountains at 7000 ft.; in fl. Sept.; n. 1414.

Folia 1·5–2 cm. long., summum totidem lat.; petioli circa 5 mm. long. Spicastra evoluta circa 3 cm. long. Bracteæ perpaucæ a me scrutatæ 2·5 × 2·5–5 × 5 mm., griseo-pubescentes. Flores dilute purpurei. Calyx sub anthesi 6·5 mm. long., ima basi 3 mm. ore 6·5 mm. lat.; lobus posticus 5 × 3 mm.; lobi laterales 3 mm. long. Calyces fructescentes desunt. Corollæ tubus

12 mm. long., basi 3·5 mm. faucibus 5·5 mm. lat.; labii postici lobus intermedius 4×4 mm., lobi laterales 1·5 mm. long.; labium anticum 6×7 mm. Filamentorum anticorum pars libera vix 2 mm. long., pars conjuncta 1 mm. lat. Stylus crassiusculus, exsertus; stigmatis lobi suborbiculares, ægre 1 mm. long.

A very distinct species by reason of the small leaves with flabellate nervation and the close silvery tomentum.

N. E. Brown reduces this genus to *Orthosiphon*, as he finds the degree of cohesion between the filaments of the front pair of stamens to vary very much in flowers of the same species, while occasionally the filaments are free to the base. It has been thought advisable to leave the nomenclature as above until this point has been thoroughly elucidated.

HOSLUNDIA VERTICILLATA, *Vahl, Enum.* i. 213.
Chirinda; Boka and Chibabava, Lower Buzi; open woods at Beira; in fl. Nov., Dec.; nn. 386, 1967, 1968, 1973.
Distrib. Tropical Africa.

PYCNOSTACHYS URTICIFOLIA, *Hook. Bot. Mag.* t. 5365.
Outskirts of Chirinda, 3800 ft.; in fl. May; n. 521.
Distrib. Tropical East Africa.

P. RETICULATA, *Benth. in DC. Prod.* xii. 83.
Near the Upper Buzi at 3500 ft.; in fl. May; n. 1954.
Distrib. Tropical East Africa.

PLECTRANTHUS LAXIFLORUS, *Benth. in E. Mey. Comm.* 228.
Chirinda Forest, 3700–4000 ft.; in fl. April, May; nn. 341, 467.
Distrib. South Africa.
Not hitherto recorded as a tropical species.

P. FLORIBUNDUS, *N. E. Br. in Kew Bull.* 1894, 12.
Mt. Maruma, 3500 ft.; in fl. Sept.; n. 1997.
Distrib. Natal.

P. FLORIBUNDUS, *N. E. Br.*, var. LONGIPES, *N. E. Br. l. c.* Chirinda, 3800 ft.; in fl. Sept.; n. 237.
Distrib. Angola to Nyasaland and German East Africa.
The type form is new to Tropical Africa.

PLECTRANTHUS (Germanea § Coleoides) CHIMANIMANENSIS, *S. Moore*, sp. nov.

Herbaceus, spithameus vel ultra, caule ascedente fere a basi folioso sparsim pubescente vel puberulo, foliis parvis late ovatis suborbicularibusve obtusis basi in petiolum manifestum subito angustatis margine crenatis crassiusculis utrobique sparsim pubescentibus, spicastris sat elongatis inferne breviramosis superne simplicibus sparsim pubescentibus, verticillastris sæpissime 4–6-floris

(ramulorum 1–3-floris) sessilibus, bracteis parvis lineari-oblanceolatis vel vato-lanceolatis obtusiusculis diutule persistentibus, pedicellis calyces circao æquantibus, calycis sub anthesi campanulati extus puberuli glandulis rubris sessilibus onusti tubo limbum æquante lobo postico ovato obtuso margine crispulo lobis lateralibus triangularibus sursum attenuatis lobis anticis similibus nisi paullulum latioribus, corollæ tubo ex calyce eminente dorso gibboso ad fauces usque gradatim attenuato labii postici lobo intermedio obovato bilobulato quam lobi laterales ovato-oblongi multo longiore labio antico postico æquilongo cymbiformi obtuso, genitalibus breviter exsertis.

Hab. On crags of the Chimanimani Mountains at 7000 ft.; in fl. Sept.; n. 2019.

Folia solemniter 1·2–1·8 cm. long., 1–1·7 cm. lat., ut caulis glandulis rubris sessilibus utrinque inspersa; crenellæ 0·5–1·5 mm. alt., ± 2 mm. long.; petioli 2–5 mm. long., pubescentes. Spicastra summum fere 10 cm., bracteæ ± 3 mm., pedicelli sæpissime 3–5 mm. long. Flores purpurei. Calyx 4 mm. long., tubus 2 mm.; lobus posticus patens, 2·2 mm. long., lobi ceteri circa 2 mm. Corolla circa 8 mm. long.; tubus 5·5 mm. long., ima basi 1·5 mm. lat., inde subito ad 3 mm. auctus, faucibus 1·5 mm. lat.; labii postici lobus intermedius 3 × 2·5 mm.; lobi laterales 1 mm. long. vel paullulum ultra; labium anticum fere 4 mm. long. Filamenta 4–5 mm. ex corolla eminentia, stylus 3 mm.

PLECTRANTHUS (Germanea § Coleoides) PETRENSIS, *S. Moore*, sp. nov.

Circiter spithameus caule ascendente verisimiliter simplici crassiusculo pube grisea obtecto, foliis longipetiolatis suborbicularibus margine crenatis vel fere integris pagina superiore pubescentibus inferiore griseo-villosulo-tomentosis, spicastris caulem longe excedentibus simplicibus glanduloso-pubescentibus dein puberulis, verticillastris pluribus 6–8-(summis paucius-) floris inter se sat distantibus, pedicellis calyces plane excedentibus, calycis sub anthesi campanulati glanduloso-puberuli tubo limbum æquante lobo postico suborbiculari obtusissimo lobis reliquis oblongo-lanceolatis æquilongo, corollæ fere glabræ tubo exserto postice gibboso juxta medium leviter attenuato faucibus paullulum amplificatis labio postico 5-lobo lobis omnibus oblongo-ovatis obtusissimis labio antico cymbiformi anticum æquante, genitalibus breviter exsertis.

Hab. Crags of the Chimanimani Mountains at 7000 ft.; in fl. Sept.; n. 2018.

Caulis circa 5 cm. long., foliorum juga plerumque 2–3 ferens. Folia summum 2·5 × 3 cm., sæpe equidem circa 12 × 15 mm., firme membranacea, costis satis perspicuis pagina inferiore percursa; crenaturæ summum 8 mm. long., 2 mm. alt., sæpissime vero breviores; petioli 1–1·5 cm. long., tomentosi. Spicastra saltem 10 cm. long. Verticillastra vetustiora 1·5–2 cm. inter se distantia, juniora magis approximata. Pedicelli 3·5–5 mm. long. Flores purpurei. Calyx ægre 3 mm. long.; lobus posticus 1·4–1·2 mm.; lobi

laterales obtusiusculi, antici brevissime acuminati. Corollæ tubus fere 6 mm. long., ima basi 2·2 mm., paullo supra basin 2 mm., ore 2·8 mm. lat.; labium posticum vix 5 mm. long., hujus lobi circa 1·5 mm. long. Filamenta 3 mm. ex tubo corollæ eminentia.

Near *P. flaccida*, Gürke, but different, *inter alia*, in clothing, leaf and corolla.

Plectranthus (Germanea § Germanea) Swynnertonii, *S. Moore*, sp. nov. Herba caule erecto subsimplici gracili minute puberulo, foliis longipetiolatis ovatis obtusis basi rotundatis ipsa cordatis margine duplice crenato-lobulatis tenuiter membranaceis pagina superiore pilis appressis brevibus strigillosis sparsim indutis pagina inferiore præter costas costulasque minute puberulas glabris, spicastris folia excedentibus paucis vel subsolitariis minute puberulis, verticillastris pluribus sessilibus subremotis plerumque 3–6-floris, bracteis parvulis lanceolatis acutis, pedicellis bracteas superantibus puberulis, calycis sub anthesi parvi glabri lobo postico tubo æquilongo suborbiculari lobis ceteris lineari-lanceolatis anticis acuminatis laterales acutos breviter excedentibus, calycis fructescentis decurvi aucti subcylindrici tubo lobis longiore, corollæ mediocris tubo calycem pluries excedente postice saccato superne leviter attenuato labio antico cymbiformi quam posticum 4-lobum paullulum breviore.

Hab. Chirinda Forest, 3700–4000 ft.; in fl. & fr. Feb.; n. 337.

Foliorum limbus modice 6·5–9·5 cm. long., summum 4·5–6 cm. lat. (accedunt pauca juxta solum genita 1·5–2·5 × 1·1–1·3 cm.) in sicco viridis subtus viridi-griseus; costæ secundariæ utrinque 6 arcuato-ascendentes; costularum reticulum laxatum; lobuli solemniter circa 5 mm. alt. et 5–8 mm. long., horum crenellæ 1–2 mm. alt.; petioli ad 7·5 mm. usque long., sed plerumque breviores. Spicastra 20 cm. attingentia; horum internodia circa 1·5 cm. long. Bracteæ 1·5–2 mm. long.; pedicelli 3–4 mm. Flores albi. Calycis sub anthesi tubus ut lobus posticus 1 mm. long.; lobi laterales 1 mm., lobi antici 1·5 mm. long. Calyx fructescens 8·5 mm. long.; tubus 4 mm. long., ore 2·5 mm. lat.; lobus posticus 3 × 4 mm.; lobi laterales 2 mm.; antici 3 mm. long. Corollæ tubus 7 mm. long., ima basi 1·2 mm. cito usque ad 3–3·5 mm. dilatatus, ore 2–2·5 mm. lat.; labium anticum 6·5 mm. long., posticum 7·5 mm., hujus lobi laterales oblongi, obtusi, margine ciliati, lobi intermedii obovati, obtusissimi, omnes circa 2 mm. long. Filamenta longiuscule exserta; antheræ parvulæ, 0·6 mm. long.

Near *P. fruticosus*, L'Hérit., but markedly different in leaf and corolla.

Plectranthus (Isodon § Pyramidium) caudatus, *S. Moore*, sp. nov. Herba caule ascendente robusto inferne foliorum delapsorum cicatricibus sparsim onusto superne folia pauca approximata gerente tomento laxiusculo griseo obducto, foliis breviter petiolatis nisi sessilibus subsessilibusve obovatis vel late obovato-oblongis obtusissimis basi obtusis vel rotundatis margine

crenatis crenellis mediocriter altis pergamaceis utrobique dense cano-tomentosis, spicastris simplicibus validis e verticillastris numerosis sessilibus plurifloris dense confertis compositis, bracteis amplis ovatis vel ovato-oblongis acutis vel acuminatis tomentosis coloratis, floribus mediocribus subsessilibus, calycis anguste campanulati tomentosi sub fructu parum aucti lobis tubum excedentibus inter se subæqualibus lanceolatis acutis tribus posticis quam antici altius connatis, corollæ puberulæ tubo calycem breviter excedente inferne cylindrico sursum curvato faucibus obliquis inflatis labio postico 4-lobo lobis subæqualibus abbreviatis deltoideis obtusis conduplicatis labio antico postico subæquilongo alte cymbiformi, filamentis sat longe exsertis crassiusculis.

Hab. Chimanimani Mountains at 7000 ft.; in fl. Sept.; n. 2010.

Caulis foliis orbus 7–14 cm. long., 5–7 mm. diam. Folia nunc 8–10 × 4·5–5·5 cm., nunc circa 3–4 × 2·5–3 cm., tomento griseo vel dilute griseo-brunneo; crenellæ sæpe 2 mm. alt., 3–5 mm. long.; costa media crassissima, costæ ordinis secundi costulæque paginæ inferioris prominentes; petioli dum adsint 5–7 mm. long., tomentosi. Spicastrum adhuc vix profecto evolutum 18 cm. long., corollis pansis exclusis 1·5 cm. lat. Bracteæ solemniter 6–8 mm. long., pedicelli 1 mm. Flores purpurei. Calyx sub anthesi 5 mm. long., tubus 2 mm.; labium posticum 3 mm. long., hujus lobi 2 mm.; lobi antici fere 3 mm. long. Calyx fructescens 7 mm. long.; tubus 3 mm., labium posticum 4 mm. long. Corollæ tubus 5–6 mm. long., inferne vix 2 mm. lat., ore 4·5 mm.; labium posticum 4 mm. long., hujus lobi circa 1 mm.; labium anticum 4·5 mm. long. Nuculæ late ovoideæ, leves, 1 mm. long.

A very distinct species, somewhat of the habit of *Coleus comosus*, Hochst.

PLECTRANTHUS HOSLUNDIOIDES, *Bak. in Fl. Trop. Afr.* v. 418.

Near Chirinda; Chipetzana River, at 3000 ft.; in fl. April, May; nn. 445, 1989.

Distrib. German East Africa.

COLEUS (§ Dissitiflori *) SWYNNERTONII, *S. Moore*, sp. nov.

Herba elata caule erecto satis valido superne ramoso ad nodos aliquantulum tumido minute puberulo mox glabro, foliis amplis ovatis apice cuspidato-acuminatis ipso obtusis e basi latissima in petiolum longum subito cuneatim angustatis margine prominenter serrato-crenatis tenuiter membranaceis supra pilis brevibus albis appressis subsparsim instructis subtus costis minute puberulis exemptis glabris, floribus in racemos compositos caulem ramulosque terminantes sæpeque folia excedentes glanduloso-pubescentes digestis, bracteis subulatis puberulis quam pedicelli filiformes glanduloso-pubescentes brevioribus, calycis sub anthesi campanulati sparsim glandulosi lobo postico

* Sectio nova. Flores solitarii nec in verticillastros dispositi, racemum simplicem vel compositum referentes. Calycis lobus posticus acuminatus, quam ceteri summum paullulum major. Calyx fructescens decurvus, ore villoso instructus.

lanceolato lobis lateralibus lineari-lanceolatis anticis linearibus omnibus quam tubus longioribus acuminatis, calycis fructescentis bene aucti demum decurvi tubo cylindrico antice gibboso ore villoso quam lobi inter se subæquales erecti plane longiore glanduloso-puberulo, corollæ tubo calycem excedente extus fere glabro inferne attenuato superne defracto necnon amplificato labii postici quadrato-obovati lobis 4 lateralibus oblongis intermediis obovatis omnibus obtusissimis labio antico posticum excedente cymbiformi.

Hab. Outskirts of Chirinda, 3700–4000 ft. ; in fl. May ; n. 349.

Foliorum adultorum limbus 9–15 cm. long., 7–10 cm. lat. (exstant vero folia minora 5–7 × 4·5–5 cm.) in sicco sæpissime subsaturate viridis, facie inferiore paullo pallidior ; crenellæ modice 4–7 mm. long., 2–3 mm. alt. ; petioli 2·5–6 cm. long., foliorum summorum breviores. Inflorescentiæ sæpe 10–15 × 8–10 cm. Bracteæ 2–3 mm. long. Pedicelli tandem 5–8 mm. long. Calycis tubus sub anthesi 1·5 mm. long. ; lobus posticus 3·5 mm. long., dimidio inferiore 1·5 mm. lat.; lobi ceteri 3·5 × 0·5–0·7 cm. Calycis fructescentis in toto 12 mm. long. tubus 7·5 × 3–3·2 mm., nervis 10 prominentibus percursus, in sicco nitidus ; lobi 4·5 cm. long. Corollæ cæruleæ tubus pars attenuatus 6 × 1 mm.; pars dilatata 4 × 4·5 mm.; labium posticum 4 × 4·3 mm.; lobi laterales 1 × 0·75 mm.; lobi intermedii 1·5 mm. long. et lat. ; labium anticum 8 mm. long., explanatum 6 mm. lat. Vagina staminea 4 mm. long. Nuculæ subcirculares, plano-convexæ, brunneæ, 1 mm. diam.

A curious plant allied to *C. umbrosus*, Vatke, which should therefore be referred to the same section.

Coleus (§ Solenostemonoides) gazensis, *S. Moore*, sp. nov.

Herba verisimiliter satis elata, caule erecto sursum ramoso distanter folioso minute pubescente, foliis petiolatis ovatis vel ovato-oblongis obtusis basi rotundatis leviterve cordatis margine crenatis tenuiter membranaceis primo pubescentibus cito supra fere glabris subtus nervis pubescentibus exemptis puberulis, spicastris folia multo excedentibus pubescentibus e cymis pedunculatis numerosis oppositis (raro suboppositis) satis approximatis plurifloris pubescentibus sistentibus ita paniculam thyrsoideam referentibus, bracteis linearibus vel anguste lineari-lanceolatis pubescentibus, floribus mediocribus breviter pedicellatis, calycis sub anthesi parvi campanulati pubescentis tubo lobis æquilongo lobis inter se fere æqualibus (lobo postico ceteris paullulum latiore) lineari-oblongis obtuse acutis intus piloso-pubescentibus, calycis fructescentis summum leviter patentis tubo comparate elongato antice gibbo quam lobi levissime aucti plane longiore intus glabro, corollæ extus piloso-puberulæ tubo calycem longe excedente inferne tenui superne defracto dilatatoque labii postici quadrati 4-lobi lobis lateralibus late oblongis quam ceteri ovato-oblongi breviore omnibus obtusissimis labio antico late cymbiformi postico longiore, filamentis basi breviter connatis.

Hab. Melsetter, 6000 ft. ; in fl. April ; n. 1998.

Folia 4–5 cm. long., 3–3·5 cm. lat., summa imminuta in bracteas transeuntia ; crenellæ circa 2·5 mm. alt., basi 2–3 mm. lat. (raro usque ad 6 mm.); petioli 1–1·5 cm. long., foliorum summorum modo 3 mm. Spicastra saltem 12 cm. long., 8 cm. diam. Bracteæ ± 3 mm. long. Cymarum pedunculi gracillimi, 5–10 mm. long. ; pedicelli 1–4 mm. long. Flores cærulei. Calyx sub anthesi 2·2 mm. long. ; lobi virides, 1·2 mm. long. Calyx fructescens tandem fere 7 mm. long., deorsum 3 mm., ore 2 mm. lat. ; lobi 1·5 mm. long. Corollæ tubi pars inferior 3·25 mm., pars superior ægre 4 mm. long., hæc superne 3·5 mm. lat. ; labium posticum 2·5 mm. long., lobi laterales 0·7 mm. lobi intermedii 1·2 mm. long. ; labium anticum 4·5 mm. long., explanatum totidem lat. Filamentorum vagina 1 mm. long. Nuculæ plano-convexæ, brunneæ, 1 mm. diam.

In general appearance this is much like *C. polyanthus*, S. Moore, but the calyx and corolla are in several respects diverse.

Although the calyx appears not to turn downwards, I have placed this in the § *Solenostemonoides* : the only alternative would be to make a new section for its reception.

Micromeria biflora, *Benth. in DC. Prod.* xii. 220.
Malsetta, 6000 ft. ; in fl. Sept. ; n. 1971.
Distrib. Tropical and South Africa, and India.

Calamintha masukensis, *S. Moore*, comb. nov.
Leucas masukensis, Bak. in. Kew Bull. 1898, 162.
Melsetter, 6000 ft. ; in fl. April ; nn. 1990, 1991.
Distrib. Nyasaland.

Achyrospermum Carvalhi, *Gürke in Engl. Pflanzenw. Ost-Afr.* C. 343 (ex descript.).
Chirinda Forest, 3700–4000 ft. ; in fl. May ; n. 78.
Distrib. Mozambique.

One of the commonest large shrubs of the Chirinda undergrowth. The bright red blossoms are very attractive to the sunbirds *Cinnyris olivacea* and *Anthothreptes zambesiana*.

Stachys æthiopica, *Linn. Mant.* i. 82.
Chimanimani Mountains at 7000 ft. ; in fl. Sept. ; n. 1972.
Distrib. Nyasaland, South Africa.

Leucas milanjiana, *Gürke in Engl. Jahrb.* xxii. (1895) 141.
Near Chirinda, 3800 ft.; Zona River, Jihu, at 2000 ft.; open woods at Beira; in fl. April, May, Nov., Dec. ; nn. 385, 509, 1994, 1995.
Distrib. Nyasaland, Mozambique.

Leonotis mollissima, *Gürke in Engl. Jahrb.* xxii. (1895) 141.

Outskirts of Chirinda, 3700–4000 ft.; Chikambogé Valley, 3000 ft.; in fl. June, Sept.; nn. 235, 1969.

Distrib. Angola to German East Africa.

"A very tall herb, up to 10 feet, with sienna-orange or creamy white flowers very attractive to birds of all kinds. 'Wilde daga' of Dutch. Leaves used as cattle medicine; also as one of the constituents of an antidote to snake-bite."

Leonotis spectabilis, *S. Moore*, sp. nov.

Herbacea, elata, caule stricto valido pubescente, foliis petiolatis subsessilibusve ovatis vel ovato-oblongis utrinque obtusis margine sat argute crenatis supra villoso-velutinis subtus tomento denso longoque albo-griseo obtectis, verticillastris paucis subdistantibus magnis globosis, bracteis exterioribus linearibus vel anguste lineari-lanceolatis spinuloso-acuminatis pubescentibus interiores lineares plus minus excedentibus, floribus magnis pedicellis pubescentibus insidentibus, calycis tubuloso-infundibularis pubescentis sub fructu vix aucti tubo dentes pluries superante dente postico elongato triangulari sursum caudato-spinoso dentibus reliquis 7 inter se parum inæqualibus (anticis paullo majoribus) triangularibus apice spinulosis, corollæ castaneæ bene exsertæ tubo superne gradatim dilatato quam labium posticum villosum manifeste breviore.

Hab. Chimanimani Mountains; in fl. Sept.; n. 2013.

Planta trimetralis. Caulis 5 mm. diam. speciminis nobis obvii præter ramulos perbreves foliatos ex axillis foliorum evolutorum ortos simplex; internodia 5–7 cm. long. Folia solemniter 4·5–6 × 3·5–4 cm. (summa perpauca minora), pergamacea, crenellæ ægre 3 mm. alt. et long. 4 mm. Verticillastri (corollis exemptis) 7·5–8 cm. diam. Bracteæ exteriores 1·5 cm. long. vel paullulum ultra, interiores 5–13 mm. Pedicelli 1–3 mm. long. Calycis tubus 1·7 cm. long., basi 2 mm. ore 7 mm. lat.; dens posticus ægre 1 cm. long.; dentes laterales 2·5–3 mm., antici 3·4 mm. Corolla tota 4·1 cm. long.; tubus 1·6 cm., labium posticum 2·5 cm., anticum 3·4 mm. long. Nuculæ maturatæ haud suppetunt.

This resembles *L. mollissima*, Gürke, in foliage, but the flowers of that are markedly smaller and the calyx is different in several respects. It is nearer *L. Engleri*, Gürke—known to me only by description—a plant with tomentose branches, smaller leaves, a tubular calyx with a shorter hinder tooth and side-teeth different in shape from the lower ones, and smaller corollas.

MONOCHLAMYDEÆ.

By SPENCER LE M. MOORE.

NYCTAGINEÆ.

BOERHAAVIA ADSCENDENS, *Willd. Sp. Pl.* i. 19.

Chibabava, Lower Buzi, 400 ft.; in fl. & fr. Dec.; nn. 1747, 1747 *a*.

Distrib. Tropical Africa.

A common weed in cultivated ground.

ILLECEBRACEÆ. (E. G. BAKER.)

Except the following, *Corrigiola littoralis*, Linn., is the only representative of this order in the collection. It is a weed of wide distribution.

CORRIGIOLA DRYMARIOIDES, *Bak. fil.*, sp. nov.

Herba humilis, repens, caulibus elongatis viridibus glabris; stipulis ovatis vel subovatis scariosis; foliis viridibus sessilibus vel subsessilibus ovatis vel oblongo-ovatis basi rotundatis vel late cuneatis apice acutis sæpissime alternis rarissime oppositis quam internodiis sæpissime brevioribus rarius longioribus margine integris; floribus parvulis in cymas axillares et pedunculatas dispositis bracteatis cymis quam foliis longioribus; calyce alte quinquepartito calycis segmentis obtusis medio viridibus marginibus membranaceis; petalis 5 quam calycis segmentis paullo brevioribus; staminibus 5; ovario ovoideo; stylo brevissimo 2-partito segmentis recurvis; ovula funiculo filiformi orto e basi suspensa; fructu subgloboso calycis segmentis incluso; seminibus ovoideo-globosis.

Hab. Chimanimani Mountains at 7000 ft.; in fl. & fr. Sept.; n. 2159. A trailing herb common among the crags.

Caules debiles, usque ad 35 cm. longi. Internodia 5–18 mm. longa. Stipulæ 1·5–2·5 mm. longæ. Folia 7–12 mm. longa, 5–9 mm. lata. Bracteæ circa 1·5 mm. longæ. Calycis segmenta circ. 2 mm. longa. Capsula circiter 1·5 mm. diam.

The sessile or subsessile ovate leaves and the comparatively few-flowered axillary cymes at once distinguish this from the only other African species.

PHYTOLACCACEÆ.

PHYTOLACCA DODECANDRA, *L'Hérit. Stirp. Nov.* 143.

Mt. Maruma, 3500 ft.; Lusitu River at about 3000 ft.; in fl & fr. Sept. Oct.; nn. 2116, 2117, 2118.

Distrib. Tropical and South Africa, Madagascar.

AMARANTACEÆ.

The following common weeds do not require localisation, viz.: *Ærva lanata*, Juss., and *Achyranthes aspera*, Linn.

CELOSIA TRIGYNA, *Linn. Mant.* 212.
Chipete forest patch; 3800 ft., Upper Buzi river at 3000 ft.; Madanda forests at about 400 ft.; in fl. April, May; nn. 507, 1514, 1517.
Distrib. Tropical Africa, Madagascar, Arabia.

AMARANTHUS GRÆCIZANS, *Linn. Sp. Pl.* 990.
Near Chirinda, 3800 ft.; in fl. May; n. 463.
Distrib. Eritrea to Angola and Zambesia.

CYATHULA PROSTRATA, *Blume, Bijdr.* 549.
Chirinda Forest, 3700–4000 ft.; in fl. April, May; nn. 269 *a*, 340.
Distrib. Liberia and Uganda to Angola and Congo Free State.

PSILOTRICHUM CONCINNUM, *Bak. in Kew Bull.* 1897, 279.
Madanda forests at about 400 ft.; in fl. Dec.; n. 1520.
Distrib. Nyasaland.

P. GRACILENTUM, *C. B. Clarke in Fl. Trop. Afr.* vi. Sect. 1, 59.
Umvumvumvu River, 400 ft.; Northern Melsetter, 5000–6000 ft.; in fl. April, Oct.; nn. 777, 6640.
Distrib. Angola to Zambesia.

ACHYRANTHES BIDENTATA, *Blume, Bijdr.* 545.
Chirinda Forest, 3700–4000 ft.; in fl. June; n. 1510.
Distrib. Cameroons to Angola and Nyasaland.

CHENOPODIACEÆ.

Chenopodium album, Linn., is a cosmopolitan weed, and *C. ambrosioides*, Linn., a weed of the tropics and the warm temperate zones.

CHENOPODIUM SCHRADERIANUM, *Rœm. & Schult. Syst. Veg.* vi. 260.
Melsetter, 6000 ft.; in fl. April; n. 1507.
Distrib. Tropical and South Africa and America.

POLYGONACEÆ.

POLYGONUM SERRULATUM, *Lag. Gen. & Sp. Pl.* 14.
Inyamadzi Valley, 2500 ft.; Lower Umswirizwi River, 1000 ft.; in fl. Sept., Nov.; nn. 1513, 1515.
Distrib. Tropical Africa.

POLYGONUM LANIGERUM, *R. Br. Prod.* 419; var. γ. AFRICANUM, *Meissn. in DC. Prod.* xiv. 117.

Umtifu River, Lower Buzi, 500 ft.; in fl. Jan.; n. 1511.

Distrib. (of species). Tropical and South Africa, East Indies, Tropical Australia.

P. ACUMINATUM, *H. B. K. Nov. Gen. & Sp. Pl.* ii. 178.

Upper Buzi, 3000 ft.; Chirinda Forest, 3700–4000 ft.; in fl. June, Dec.; nn. 356, 1512.

Distrib. Tropical and South Africa, Tropical America.

RUMEX ABYSSINICUS, *Jacq. Hort. Vind.* iii. 48.

Melsetter, 6000 ft.; in fl. April; n. 1506.

Distrib. Tropical Africa.

PODOSTEMACEÆ.

HYDROSTACHYS POLYMORPHA, *Klotzsch in Peters Mossamb. Bot.* 506.

Mangezi River, Northern Melsetter, at 4000 ft.; n. 818.

Distrib. Zambesia, Nyasaland.

ARISTOLOCHIACEÆ.

ARISTOLOCHIA PETERSIANA, *Klotzsch in Monatsber. Akad. Berlin*, 1859, 599.

Beira beach; in fl. Dec.; n. 1768.

Distrib. Nyasaland, Zambesia, Northern Transvaal.

PIPERACEÆ.

PIPER CAPENSE, *Linn. fil. Suppl.* 90.

Chirinda Forest, 3700–4000 ft.; Mt. Pene Forest at 6500 ft.; in fl. June; nn. 66, 1097.

Distrib. Tropical and South Africa.

A straggling shrub 6–9 feet high, very plentiful in some parts of the forest.

PEPEROMIA REFLEXA, *A. Dietr. in Sp. Pl.* i. I. 180.

Chipete, 3800 ft.; in fl. May; n. 426 *a*.

Distrib. Tropics and subtropics of both hemispheres.

P. MASCHARENA, *C. DC. in Journ. Bot.* iv. (1866) 135.

Chipete forest patch, 3800 ft.; in fl. May; n. 426.

Distrib. East Tropical and South Africa, Madagascar.

MONIMIACEÆ.

XYMALOS MONOSPORA, *Baill. in Bull. Soc. Linn. Paris*, i. (1887) 650.

Chirinda Forest, 3700–4000 ft.; Chimanimani Mts. at 7000 ft.; in fl. June, Sept.; nn. 663, 1112.

Distrib. Tropical East Africa, South Africa.

LAURINEÆ.

Cassytha filiformis, Linn., a parasite of wide distribution throughout the tropics, is the only representative of this order in the collection.

PROTEACEÆ.

PROTEA MADIENSIS, *Oliver in Trans. Linn. Soc.* xxix. (1875) 143.

Melsetter at 6000 ft.; Chimanimani Mts. at 7000 ft.; in fl. Sept., Oct.; nn. 629, 6097.

Distrib. Uganda to Rhodesia.

Chindao name, "Chirapadzungu"; "Sugar-bush" of settlers.

P. UHEHENSIS, *Engl. Bot. Jahrb.* xxviii. (1900) 380.

Near Chirinda, 3800 ft.; in fl. Feb.; n. 190.

Distrib. German East Africa.

Chindao name, "Chirapadzungu"; "Sugar-bush" of settlers. A shrub with white flowers common in the short open veld. Flowers particularly attractive to *Cinnyris kirkii*. The woody base remaining after the falling of the seeds is made by the natives into a button, polished and worn round the neck.

PROTEA SWYNNERTONII, *S. Moore*, sp. nov.

Frutex magnus ramis validis pilosis ultimis crebro foliosis dense piloso-pubescentibus, foliis sessilibus late oblongis angusteve oblongo-obovatis obtusissimis basin versus sensim angustatis basi ipsa subrotundatis levissime amplexicaulibus pergamaceis utrobique dense appresse piloso-pubescentibus, capitulis pro rata parvis ternis sessilibus campanulatis, involucri circa 7-serialis bracteis exterioribus intermediisque gradatim accrescentibus late ovatis obtusis vel obtusissimis coriaceis paucis intimis longioribus spathulato-oblongis obtusissimis coriaceo-scariosis bracteis omnibus dorso appresse pubescenti-velutinis, floribus ex involucro breviter eminentibus extus dense ferrugineo-villosis dilute puniceis labio inferiore anguste cymbiformi apice trifido quam superius plane majore, antheris subsessilibus anguste linearibus appendice brevi obtusa crassiuscula onustis, ovario longe ferrugineo-setoso-villoso, stylo exserto superne attenuato crassiusculo glabro.

Hab. Common on grassy mountains about Melsetter at 6000 ft.; in fl. April; n. 1411.

Rami vetustiores foliis jam orbi 15 mm. diam., quam juniores duplo crassiores, cortice fragili griseo-cinereo obducti. Folia modice circa 12 × 4 cm. (prope basin 1·5 cm. lat.), in sicco griseo-brunnea; costæ laterales utrinque circa 12, ascendentes, rectæ, raro leviter arcuatæ, pagina inferiore sæpe et pagina superiore satis perspicuæ; reticulum laxum; glandulæ immersæ crebræ. Capitula circa 4·5 × 6 cm. Involucri bracteæ exteriores 5–8 mm. long., intermediæ 10–30 mm., intimæ 40 mm. vel paullo ultra, bracteæ omnes in sicco castaneæ. Perianthium ægre 40 mm. long.; labium inferius juxta basin 5 mm. lat., ad medium 1 mm., hujus lobi laterales 2 mm. long., lobus intermedius angustus, acutus, 1·2 mm. long. Filamenta circa 0·5 mm. long.; antheræ puberulæ, 6·5 mm. long. Ovarium anguste ovoideo-oblongum, 2·2 mm. long.; stylus aliquanto complanatus, 4 cm. long.

Judging from the figure and description this seems to be near *P. Goetzeana*, Engl., which, among other features, has acute leaves, somewhat different involucral bracts, and smaller white flowers.

Leucospermum saxosum, *S. Moore*, sp. nov.

Frutex ramis validis piloso-villosulis demum glabris copiose foliosis, foliis sessilibus lineari-lanceolatis vel spathulato-oblongis basin versus sensim attenuatis apice sæpissime 3–5-dentatis rarius 3-lobis rigide coriaceis utrinque cito basi piloso-villosula exempta glabris, capitulis mediocribus breviter pedunculatis terminalibus solitariis vel perpaucis aggregatis subglobosis, pedunculis dense sericeis squamis parvis onustis, involucri campanulati bracteis parvis deltoideo-triangularibus acutis vel caudati-acuminatis extus sericeo-villosulis, receptaculo elevato, floribus longe exsertis extus sericeo-villosis rubris perianthii segmentis omnibus cohærentibus linearibus apicem versus recurvis tandem inter se basi breviter connatis, antheris sessilibus oblongis apice mucronulatis, ovario oblongo basi villoso, stylo elongato crassiusculo superne attenuato, stigmate terminali conico sulcato.

Hab. In crags of the Chimanimani Mountains at 7000 ft.; in fl. Sept.; n. 652.

Folia vulgo 5–6·5 cm. long. (raro 7 cm.), 1–1·5 cm. lat. (raro 1·7 cm.), in sicco griseola, evanide vel subevanide costata. Capitula pansa (floribus inclusis) circa 2·5 × 3·5 cm. Pedunculi circa 1 cm. long., hujus squamæ 2·5–3 mm. long. Involucri bracteæ exteriores verisimiliter persistentes, 3 mm. long., interiores 4 mm., omnes coriaceæ, hæ subrhombicæ. Perianthium 2·5 cm. long., segmenta basi 1·5–2 mm. lat., sub apice 1 mm., ipso apice 1·5 mm. Antheræ 2 mm. long. Ovarium 2 mm. long. Ovulum juxta medium loculi affixum. Stylus paullo ultra 3 cm. long., stigma vix 2 mm.

Closely allied to *L. attenuatum*, R. Br.; differing from it chiefly in the smaller bracts of the involucre, the coherence of the fourth segment of the perianth with the rest so as to form a single lip, and the shorter style. The red colour of the flower is also worthy of mention.

No species of *Leucospermum* has so far been recorded as tropical.

FAUREA SPECIOSA, *Welw. in Trans. Linn. Soc.* xxvii. (1869) 63.
Melsetter 6000 ft.; in fl. Sept., Oct.; nn. 625, 626.
Distrib. Usambara to Angola; also in Northern Transvaal.
Flowers very attractive to sunbirds, especially *Nectarinia arturi.*

F. SALIGNA, *Harv. in Hook. Lond. Journ. Bot.* vi. (1847) 373.
Near Chinde at 3500 ft.; Chimanimani Mts. at 7000 ft.; in fl. Sept., Nov., Dec.; nn. 42, 42 *a*, 1796.
Distrib. South Africa to Angola and Rhodesia.
Chindao name, "Gurahorgwe" ("Boeken-hout" of local Dutch). One of the largest trees of the open woods. Timber easily worked and durable. Wood used by natives in charcoal-making, also for doors and the floors of their raised huts.

F. RACEMOSA, *Farmar in Kew Bull.* 1908, 58.
Chimanimani Mts. at 7000 ft.; Mt. Pene at 7000 ft.; in fl. Sept., Oct.; nn. 639, 6096.
Distrib. Nyasaland.
A large tree up to 70 feet high.

THYMELÆACEÆ.

GNIDIA BUCHANANI, *Gilg, in Engl. Bot. Jahrb.* xix. (1894) 261.
Nyahodi River at 5000 ft.; in fl. Sept., Oct.; nn. 1834, 6136.
Distrib. South-East tropical Africa.

GNIDIA (§ Eugnidia) PHYLLODINEA, *S. Moore*, sp. nov.
Suffrutex spithameus sparsim ramosus caule erecto tenui fere a basi folioso glabro, foliis sessilibus sparsis casu solummodo oppositis anguste vel angustissime oblongo-lanceolatis acutis vel breviter acuminatis plane evanideve trinervibus coriaceo-membranaceis glabris, capitulis terminalibus solitariis pedunculatis circa 10-floris hujus foliis involucralibus circa 5 quam reliqua brevioribus ovatis acuminatis scariosis brunneis margine ciliatis ceteroquin glabris puberulisve, floribus tetrameris, perianthiis ex involucro eminentibus extus subtiliter sericeo-pubescentibus intus glabris horum tubo superne leviter amplificato quam lobi quadrato-oblongi obtusissimi 5-plo longiore, staminibus inclusis omnibus fertilibus, faucis squamis 4 brevibus filiformibus glabris, ovario oblongo ut stylus gracillimus duplo longior glabro.
Hab. Melsetter, 6000 ft.; in fl. April; n. 1833.
Folia 12–18 mm. long., 2–3 mm. lat., basin versus leviter angustata, in sicco griseolo-viridia. Pedunculus $\pm$ 1 cm. long., sub capitulo aliquantulum incrassatus. Capitula pansa circa 7 mm. diam. Folia involucralia 5 mm. long., juxta basin 2–3 mm. lat. Perianthii flavi pars decidua 9 mm. long.;

tubus 7 mm. long., inferne 1 mm. lat., superne 1·5–1·75 mm.; lobi 2 mm. long.; pars persistens 3 mm. long. Faucis squamæ circa 0·75 mm. long., levissime clavellatæ, crassiusculæ. Antheræ oblongæ, squamis æquilongæ. Ovarium 1·25 mm., stylus 2·5 mm. long.

As regards foliage this is homoplastic with *G. apiculata*, Gilg, a much taller freely branching plant with larger sessile heads and a different involucre.

LASIOSIPHON RORIDUS, *S. Moore*, sp. nov.

Suffrutex caule erecto parum ramoso villoso, foliis sessilibus plus minus imbricatis oblongis vel anguste oblongo-ovatis obtusis utrinque dilute fulvo-villosis, capitulis terminalibus solitariis plurifloris pedunculis elongatis fulvide hirsuto-tomentosis suffultis, foliis involucralibus ceteris similibus nisi minoribus, floribus 5-meris, perianthii exserti parte persistente dense villosa parti deciduæ extus tomentosæ intus glabræ circiter æquilonga lobis anguste obovato-oblongis obtusissimis quam tubus multo brevioribus, staminibus superioribus breviter exsertis, faucis squamis perspicuis ovatis retusis vel bifidis, ovario ovoideo-oblongo villoso, stylo incluso glabro.

Hab. Melsetter at 6000 ft.; in fl. Oct.; n. 6134.

Planta paullo ultraspithamea. Folia vulgo 2–3 cm. long., 6–10 mm. lat., in sicco tandem brunneo-castanea pilis longis dilute fulvis copiose obsita. Pedunculi 10–15 cm. long., ipso sub capitulo incrassati. Folia involucralia circa 13 × 3 mm. Perianthii pars persistens superne angustata, 7·5 mm. long.; pars decidua cylindrica, 8 mm. long.; lobi 3 × 2 mm. Antheræ oblongæ, 1·3 mm. long. Squamæ glabræ fere 1·5 mm. long. Ovarium vix 2 mm. long., stylus circa 5 mm.

This differs from *L. Hoepfnerianus*, Vatke, chiefly in the villous indumentum, the longer peduncles, longer persistent part of the perianth, and the larger scales in the throat.

The flowers are dull yellow. The plant grows in masses on the higher slopes, its hairy leaves holding the dew till quite late in the day, like a sponge full of water.

L. KRAUSSI, *Meissn. in DC. Prod.* xiv. 596.
Mt. Pene, 6500–7000 ft.; in fl. Sept.; n. 1787.
Distrib. Tropical and South Africa.

SYNAPTOLEPIS ALTERNIFOLIA, *Oliver in Hook. Ic. Pl.* t. 1194.
Kurumadzi River, Jihu, 2000 ft.; in fl. Nov.; n. 1785.
Distrib. Nyasaland.

S. LONGIFLORA, *Gilg in Engl. Bot. Jahrb.* xix. (1894) 276.
Near Chirinda 3500 ft.; in fl. Oct.; n. 188.
Distrib. Mozambique.

PEDDIEA DREGEI, *Meissn. in DC. Prod.* xiv. 528.
Chipete forest patch; Mt. Pene at 6500 ft.; in fl. Jan.; nn. 123, 123 *a*.
Distrib. Natal.

LORANTHACEÆ. (T. A. SPRAGUE.)

LORANTHUS DREGEI, *Eckl. & Zey. Enum.* 358; forma OBTUSIFOLIA, *Engl. in Bot. Jahrb.* xx. (1894) 105. Beira beach; in fl. Dec.; n. 1082.
Distrib. (of variety). East tropical Africa.

L. BULAWAYENSIS, *Engl. in Engl. Bot. Jahrb.* xl. (1908) 536.
Umvumvumvu River at 4000 ft.; in fl. Oct.; n. 6001.
Distrib. Rhodesia.

LORANTHUS (§ Ischnanthus) SWYNNERTONII, *Sprague*, sp. nov.
Ramulis etiam juvenilibus glabris, foliis oppositis petiolatis ovatis acute acuminatis basi obtusis vel rotundatis coriaceis glabris opacis margine exsiccando leviter crispatis nervis utrinque prominulis lateralibus utroque latere 4–6 obliquis vel patulis, umbellis axillaribus solitariis 8–13-floris, bracteis e basi patelliformi breviter ovatis vel oblongis apice rotundatis vel emarginatis ciliolatis dorso late umbonatis, calyce ascendente leviter lobato sparse ciliolato, corollæ tubi parte basali oblongo-ellipsoidea lobis leviter reflexis a basi ad medium sensim angustatis deinde spathulato-ampliatis, filamentorum parte adnata densissime glandulosa parte libera ultra insertionem dentis producta dente anguste triangulari acuto, antheris oblongo-linearibus apice minute bicuspidatis, disco breviter lobato, bacca anguste obovoidea.

Hab. Chirinda Forest, 3700–4000 ft., parasitic on *Vernonia podocoma*, Sch. Bip.; in fl. Dec.; n. 141.

Internodia ramulorum 2–3·5 cm. long. Foliorum lamina 5·5–9 cm. long., 2·5–4 cm. lat.; petiolus 6–8 mm. long. Pedunculus 3–10 mm. long.; pedicelli 6–8 mm. long. Bractea postice 1·5 mm. long., antice circiter 0·4 mm. Receptaculum 1·5 mm. long. Calyx 1·3 mm. long. Corolla in toto 2 cm. long.; tubi pars basalis 4–4·5 mm. long.; lobi 11 mm. long., superne 1–1·3 mm. lat. Filamenta 1 mm. supra basin corollæ loborum inserta, 5–6 mm. long. Antheræ 2–3 mm. long. Discus 0·5 mm. altus. Bacca 5–6 mm. long.

L. Swynnertonii may be distinguished from the other species of the section *Ischnanthus* by the very densely glandular adnate part of the filaments and the production of the filament beyond the insertion of the tooth.

SANTALACEÆ.

THESIUM GRACILE, *A. W. Hill in Kew Bull.* 1910, 185.
A common herb in the Umswirizwi Flats, 1100 ft.; in fl. Nov.; n. 310.
Distrib. Rhodesia.

THESIUM SCABRIDULUM, *A. W. Hill*, sp. nov.

Species foliis scabridulis stylo elongato distincta, *T. nigricanti*, Rendle, similis.

Suffrutex 30 cm. altus; caules inferiores patentes, superiores plusminusve erecti, sulcati, scabriduli. Folia in caulis parte inferiore distantia, 0·9–1·3 cm. longa, in parte superiore numerosa, 0·7–1 cm. longa, lineari-lanceolata, acuta, carinata, scabridula. Inflorescentia racemosa. Flores singuli in axillis bractearum dispositi; bracteæ foliosæ, pedicellis ex parte adnatæ, circiter 7 mm. longæ; bracteolæ 2, floribus æquilongæ vel paullo longiores. Perianthium 3·5 mm. longum, glabrum; segmentis 1·5 mm. longis, anguste ovato-lanceolatis, paullo cucullatis, marginibus sinuoso-undulatis, inflexis. Filamenta 0·5 mm. longa; antheræ 0·5 mm. longæ. Stylus antheras superans, 1·5 mm. longus. Fructus immaturus ovoideus, reticulationibus inconspicuis.

Hab. Melsetter at 6000 ft.; in fl. & fr. Sept.; n. 2124.

A large straggling herb with small yellowish flowers.

OSYRIS ABYSSINICA, *Hochst. in Flora*, xxiv. (1841) *Intell.* 22.

Melsetter 6000 ft., Northern Melsetter at 5000–6000 ft.; in fl. Sept., in fr. Oct.; nn. 622, 6102.

Distrib. Tropical Africa.

This shrub is much used in tanning.

EUPHORBIACEÆ.

EUPHORBIA SCHIMPERIANA, *Hochst. ex A. Rich. Tent. Fl. Abyss.* ii. 242.

Outskirts of Chirinda, 3700–4000 ft.; n. 1531.

Distrib. East tropical Africa: also in Arabia.

E. SCHIMPERIANA, *Hochst.*, var. BUCHANANI, *N. E. Br.* in Engl. Bot. Jahrb. xxviii. (1899) 27.

E. Buchanani, Pax.

Chirinda Forest outskirts 3800 ft.; Inyamadzi Valley 2500 ft.; in fl. Sept., Oct.; nn. 238, 1532.

E. CYPARISSOIDES, *Pax in Engl. Bot. Jahrb.* xix. (1895) 123.

Northern Melsetter, 5000–6000 ft.; in fl. & fr. Oct.; n. 6217.

Distrib. East tropical Africa.

E. CYPARISSOIDES, *Pax*, var.

Melsetter 6000 ft.; hills near Haroni River, 5500 ft.; Inyamadzi Valley, 2500 ft.; in fl. Sept., Oct.; nn. 1529, 1533, 6043, 6044.

E. DEPAUPERATA, *Hochst. ex A. Rich. Tent. Fl. Abyss.* ii. 241.

Hills near Haroni River, 5500 ft.; Mt. Pene, 7000 ft.; in fl. Sept., Oct.; nn. 1528, 6041.

Distrib. East tropical Africa.

The specimens agree with those from Mt. Milanji collected by Whyte which serve as the type of my *E. shirensis*: the bracts of this are suborbicular and quite blunt, and so markedly different from those of typical *E. depauperata*, which are acute and mucronulate. [E. G. B.]

EUPHORBIA WHYTEANA, *Bak. fil. in Trans. Linn. Soc.* ser. 2, *Bot.* iv. (1894) 39.

Chimanimani Mts. at 7000 ft.; in fl. Sept.; n. 1526.

Distrib. Nyasaland.

E. MATABELENSIS, *Pax ex Zahlbr. in Ann. Hofmus. Wien*, xv. (1900) 50.

Near Chirinda, 3500 ft.; South Umtali district, Melsetter Road; in fl. Oct.; nn. 691, 6611.

Distrib. East tropical Africa.

Chindao name, "Urimbo." Latex used as birdlime.

SYNADENIUM GAZENSE, *N. E. Brown*, sp. nov.

Folia 12–15 cm. longa, 3·5–5·5 cm. lata, breviter petiolata, longe cuneato-obovata, obtusa, supra pubescentia, subtus glabra. Cymæ 11–14 cm. longæ, 5 cm. diam., umbellatim ramosæ, ramis furcatis pubescentibus. Involucrum 6–8 mm. diam.

Chipetzana River at 3000 ft.; in fl. April; no. 1505.

This species very closely resembles *S. Grantii*, Oliver, but is at once distinguished by the short pubescence on the upper surface of the leaves and by the peduncle of the cyme umbellately dividing into 3 or 4 once-forked branches, not repeatedly forked as in *S. Grantii*. Mr. Swynnerton notes that it is a large shrub with milky latex and light green honey disks (involucral glands), and light yellow anthers. All the involucres on the specimen are male. [N. E. BR.]

BRIDELIA ATROVIRIDIS, *Müll. Arg. in Journ. Bot.* ii. (1864) 327.

Chipete forest patch, 3800 ft.; in fr. April; n. 535.

Distrib. Angola.

A large tree with straight trunk, smooth bark and dark-hearted wood. Fruits larger than those of type (8 × 7 mm.) and not narrowed above. When flowers come to hand, this may perhaps prove a new species.

B. MICRANTHA, *Baill. Adansonia*, iii. (1862–63) 164.

Lower Umswirizwi River, 1000 ft.; near Chirinda, 3500 ft.; in fl. Nov.; nn. 46, 536.

Distrib. Tropical Africa, Natal.

Chindao name, "Mushungunu." A small to medium-sized tree, 30 (occasionally 40) feet high. Timber white and exceedingly durable: it makes excellent yokes for oxen. Pounded to a fine paste, the bark is smeared by the natives over their doors and baskets to stop cracks.

BRIDELIA CATHARTICA, *Bertol. Ill. Pl. Mozamb.* Diss. iv. 16, t. 6.
Beira beach; in fl. Dec.; n. 538.
Distrib. Eastern tropical Africa.

B. NIEDENZUI, *Gehrm. in Engl. Bot. Jahrb.* xli. (1908) *Beibl.* 95, 36.
Umvumvumvu River at 2000 ft.; in fl. & fr. April; n. 1736.
Distrib. Tropical East Africa.

CLEISTANTHUS APETALUS, *S. Moore*, sp. nov.

Arbuscula ramulis ultimis gracilibus aliquanto anfractuosis pendentibus fulvo-sericeo-pubescentibus, foliis brevipetiolatis oblongo-lanceolatis superne caudato-attenuatis apice obtusis ipso mucronulatis basi obtusis leviterve rotundatis papyraceis deinde tenuiter coriaceis margine sparsim ciliata necnon nervis puberulis exemptis utrobique glabris, stipulis perspicuis lineari-lanceolatis longe acuminatis fulvo-sericeis diutule persistentibus, floribus masculis in axillis ramulorum brevium fertilium fulvo-sericeorum solitariis binisve, bracteis parvulis subulatis fugaceis, sepalis inter se sæpe inæqualibus oblongis oblanceolatisve obtusiusculis extus dense fulvo-sericeis, petalis 0, disco prominente, antheris ovato-oblongis obtusis quam filamenta suffulcientia longioribus.

Hab. Zona River, Jihu, 2300 ft.; in fl. Nov.; n. 150.

Folia solemniter 6–8 cm. long., 1·7–2·5 cm. lat., in sicco subcastanea vel brunneo-viridia; costæ ordinis secundi utrinque 5–7, valde arcuatæ, a margine satis distantes; reticulum mediocriter densum, utrinsecus sat prominens; petioli circa 5 mm. long., fulvo-sericei. Stipulæ 7–9 mm. long. Ramuli fertiles circa 1 cm. long. Bracteæ 1 mm. vix æquantes; pedicelli circa 2 mm. long. Sepala 4 mm. long., filamenta 1 mm., antheræ vix 2 mm.

Near to *C. angolensis*, Müll. Arg., for which it might almost be taken. This has, however, coarser branchlets devoid of fulvous silky pubescence, more markedly coriaceous leaves, longer flowering branchlets, and somewhat larger male flowers provided with small petals.

Owing to insufficient material, I am unable fully to describe the female flower. The ovary is subglobose, densely covered with tawny hairs and 2 mm. in length.

PHYLLANTHUS (§ Menarda) GRAMINICOLA, *Hutch.*, sp. nov.

Planta herbacea, dioica, glabra, inferne lignescens, superne ramosa, ramulis ascendentibus gracilibus dense foliosis, foliis imbricatis brevipetiolatis oblongo-ellipticis ovatis obtusis sæpe minute mucronulatis basi rotundatis firme membranaceis paginæ inferioris pallidis, stipulis parvulis subulatis integris basi haud productis ascendentibus, floribus masculis solummodo obviis in axillis vulgo 2–4-nis pedunculis quam folia plane brevioribus insidentibus, sepalis 5 late obovatis obtusissimis, glandulis alternisepalis 5 suborbicularibus

perspicuis inter se liberis incrassatis, staminibus 5 filamentis solummodo basi connatis antherarum rimis horizontalibus.

Hab. Near Chirinda, 3800 ft. ; in fl. Feb. ; n. 261.

Folia vulgo circa 7 × 4 mm., margine plana; petioli 0·5 mm. long. Stipulæ 1 mm. æquans, superne tandem recurvi. Pedicelli 2–3 mm. long. Sepala 1·5 × 1·2 mm. Glandulæ 0·4 mm. diam. Filamenta 0·5 mm. long., antheræ 0·2 mm.

Remarkably like *P. rotundifolius*, Müll. Arg., but the affinity is with *P. pentandrus*, Müll. Arg. and its allies. It can be distinguished at once from *P. pentandrus* by the diœcism and the shorter, differently shaped, reticulate leaves. [J. H.]

Phyllanthus maderaspatensis, *Linn. Sp. Pl.* 982.

Near Chirinda, 3500 ft.; Lower Buzi River, 0–400 ft.; in fl. Feb., Dec.; nn. 333, 1521.

Distrib. Tropical Africa and Natal, &c. Also from Arabia to East Indies and Tropical Australia.

P. macranthus, *Pax in Engl. Bot. Jahrb.* xix. (1894) 77.

Madanda forests at about 400 ft. ; in fl. Dec.; nn. 1756, 1757.

Distrib. Mozambique.

P. myrtaceus, *Sond. in Linnæa*, xxiii. (1850) 134.

Mt. Pene, 6500–7000 ft.; Chimanimani Mts. at 7000 ft. ; in fl. & fr. Sept., Oct. ; nn. 1522, 1523, 6155 *a*.

Distrib. South Africa.

P. discoideus, *Müll. Arg. in Linnæa*, xxxii. (1863) 51.

Madanda forests at about 400 ft. ; in fr. Dec. ; nn. 1504, 1749.

Distrib. Tropical Africa.

Phyllanthus (§ Euphyllanthus) Hutchinsonianus, *S. Moore*, sp. nov.

Frutex parvus, copiose ramosus, ramulis tenuibus frequenter foliosis subteretibus glabris, foliis parvis alternis distichis ovato-oblongis basi apiceque obtusis vel obtusissimis crassiusculis in sicco pagina superiore olivaceis pagina inferiore glaucis petiolis manifestis etsi brevibus fultis, stipulis cito reflexis subulatis acuminatis basi nequaquam productis integris scariosis, floribus monoicis ex axillis ramulorum superioribus solitatim ortis pedicellatis, florum masculorum sepalis 5 obovatis obtusissimis cum totidem glandulis suborbicularibus crassiusculis inter se liberis alternantibus, staminibus 2 filamentis in columnam tenuem alte connatis antheris rimis subobliquis dehiscentibus, florum femineorum sepalis iis masculorum similibus nisi majoribus, horum glandulis in annulum connatis, stylis abbreviatis bipartitis.

Hab. Chimanimani Mountains at 7000 ft. ; in fl. & fr. Sept. ; n. 1524.

Folia solemniter 6–8 mm. long., 3–4 mm. lat., margine aliquantulum

revoluta; petioli tenues, summum 1 mm. long. Stipulæ 1–2 mm. long., rubescentes, ramulorum maxime juvenilium approximatæ optime aspectabiles. Pedicelli vulgo 2–3 mm. long. Florum masculorum sepala ægre 2 mm. long., albicantes. Glandulæ 0·25 mm. diam. Columna staminea 1 mm. alt.; antheræ fere 0·5 mm. long. Florum femineorum sepala 4 mm. long., sub fructu adusque 5 mm. aucta. Ovarium $2{\cdot}5 \times 3$ mm. Styli ramorum crura 0·5 mm. long. Capsula in coccos 3 siccos bivalves 3 mm. long. dehiscens. Semina triangularia, dorso convexa ubi striata eleganterque insculpta, brunnea, 2·5 mm. long.

Known among allied species by the leaves, the glands of the flowers, the two stamens with the filaments united throughout and the anthers opening subobliquely. This plant seems to have a strong tendency to diœcism, only one of the specimens bearing flowers of both sexes. It is named in compliment to Mr. Hutchinson, of the Kew Herbarium, who has lately been studying the African species of *Phyllanthus* and allied genera, and has kindly helped me in naming those of the present collection.

Mr. Swynnerton notes this as being common in the forest undergrowth.

PSEUDOLACHNOSTYLIS DEKINDTII, *Pax in Engl. Bot. Jahrb.* xxviii. (1899) 20 (ex descript.).

Lower Umswirizwi River, 1000 ft.; in fl. Nov.; n. 151.

Distrib. Angola.

A small tree with spreading crown.

As Mr. Hutchinson pointed out, the specimens agree with Baum 154, named (Kunene-Samb. Exped. 285) *P. maprouneæfolia*, Pax, apparently by an oversight, for that answers much better the description of *P. Dekindtii*, Pax.

P. MAPROUNEÆFOLIA, *Pax in Engl. Bot. Jahrb.* xxviii. (1899) 20.

Umvumvumvu River at 4000 ft.; in fr. April; n. 2128.

Distrib. East and South tropical Africa.

FLUEGGEA MICROCARPA, *Blume, Bijdr.* 580.

Umswirizwi River, 1000 ft.; Chibabava, Lower Buzi, 400 ft.; Sabi River at about 1000 ft.; Umtefu River, Lower Buzi, 500 ft.; in fl. & fr. Nov.; nn. 1727, 1728, 1729, 1730, 1911.

Distrib. Tropics of the Old World.

Chindao name, "Umsosoti." Fruits edible.

UAPACA SANSIBARICA, *Pax in Engl. Bot. Jahrb.* xxxiv. (1904) 370.

Open woods near Chirinda, 3800 ft.; in fl. Jan., April; nn. 155, 6513.

Distrib. East tropical Africa.

Chindao name, "Mutongoro."

UAPACA KIRKIANA, *Müll. Arg. in Flora*, xlvii. (1864) 517.

Near Chirinda, 3500 ft.; in fl. Jan.; n. 49.

Distrib. Nyasaland, Zambesia.

A smallish tree of the open woods bearing a large 3-seeded edible fruit much relished by natives and all kinds of animals.

ANTIDESMA MEMBRANACEUM, *Müll. Arg. in Linnæa*, xxxiv. (1865–66) 68.

Near Chirinda, 3500 ft.; Chipetzana River at 3000 ft.; Mt. Pene forest at 6500 ft.; in fl. Sept., Dec., in fr. April; nn. 169, 169 *a*, 631, 1111, 2011.

Distrib. Tropical West Africa.

Chindao names, "Murunga-munga" and "Mushongo.

Var. MOLLE, *Müll. Arg. l. c.* Chibabava, Lower Buzi, 400 ft.; in fl. Dec.; n. 1789. Same Chindao names to this as to the preceding.

HYMENOCARDIA ACIDA, *Tul. in Ann. Sc. Nat.* sér. 3, *Bot.* xv. (1851) 256.

Chikore Hills, 3500 ft.; in fl. Nov., in fr. March; nn. 1214, 1519.

Distrib. Tropical Africa.

CROTON (§ Eluteria) SWYNNERTONII, *S. Moore*, sp. nov.

Arbor dioica ramulis ultimis sat tenuibus sæpius perspicue lenticelliferis, foliis petiolatis nunc late ovatis nunc ovatis nunc ovato-lanceolatis paullo infra apicem angustatis apice ipso obtusis basi late truncatis vel cuneatis margine undulatis integrisve 3-plinervibus pergamaceis utrinque sed præsertim pagina inferiore minutissime microscopice lepidotis, stipulis fugaceis ovatis obtusissimis subscariosis, racemis pedunculatis floribundis glabris masculis elongatis (folia excedentibus) femineis folia circiter æquantibus, utriusvis sexus floribus pro bractea 1 vel 2 pedicellatis, florum masculorum sepalis ovatis obtusis extus superne minute pubescentibus quam petala suborbicularia obtusissima paullulum brevioribus, receptaculo piloso, staminibus 7–8, florum femineorum sepalis brevibus triangularibus acutis pubescentibus, petalis sepala longe excedentibus suborbicularibus obtusissimis, ovario 3-loculari ovoideo fulvo-tomentoso, styli ramis semel dichotomis.

Hab. Chirinda Forest, 3700–4000 ft.; in fl. Sept.–Dec., in fr. Jan.; nn. 109, 109 *a*, 109 *b*, 109 *c*, 6519.

Folia pleraque 6–10 × 3·5–7 cm. in sicco viridia vel viridi-brunnea, utrinque subevanide nitidula; costæ reticulumque pagina utravis prominulæ; petioli 1–2 cm. long., glandulis carentes. Stipulæ circa 3 mm. long. Racemi masculi usque ad 20 cm. long.; bracteæ ovatæ circa 2 mm., pedicelli 4 mm. long., glabri. Racemi feminei circa 7 cm. long., pedicelli 4–9 mm. long., pubescentes. Florum masculorum sepala 2 mm.; petala 2·5 mm. long.; florum femineorum sepala summum 1 mm. long.; petala 4 × 3·75 mm. Ovarium 2 × 1·5 mm.

cito ad 4 × 3 mm. auctum. Styli ramorum crura torta, 2 mm. long. Capsula subglobosa, minute velutina, 13–15 × 11–14 mm. Semina brunnea, circa 9 × 8 mm.

Nearest *C. Draconopsis*, Müll. Arg., which has a stellate indumentum, differently shaped leaves, male flowers with 15 stamens and bilocular ovary.

This is a large beech-like tree with a fluted trunk and a durable timber.

CROTON SYLVATICUS, *Hochst. in Flora*, xxviii. (1845) 82.

Chirinda Forest, 3700–4000 ft.; in fl. Nov.; n. 4.

Distrib. South Africa. Not hitherto reported as tropical.

Chindao name, "Musuguta." One of the largest forest trees with brittle branches liable to be blown off by the wind. The bark is pounded and thrown into pools to poison fish, also used pulped as a poultice in cases of colic.

CROTON (§ Eucroton, Eutropia) MADANDENSIS, *S. Moore,* sp. nov.

Fruticosus, inferne nudus, ramulis ultimis foliosis primo dense stellato-pubescentibus cite glabris, foliis petiolis quam lamina longe brevioribus apice glandulis 2 parvulis pedicellatis gaudientibus insidentibus ovatis vel oblongo-ovatis acutis breviterve acuminatis basi truncatis vel leviter cordatis 3–5-plinervibus membranaceis utrobique sed præcipue pagina inferiore stellato-puberulis, stipulis linearibus pubescentibus, racemis foliis sæpissime brevioribus pedunculatis discontinuis paucifloris floribus 1–2 infimis femineis reliquis masculis omnibus 5-meris et pedicellatis et extus dense pubescentibus, bracteis oblongis exiguis, florum masculorum sepalis ovato-oblongis obtusis quam petala oblongo-obovata obtusissima paullulum brevioribus, receptaculo piloso, staminibus circa 13, florum femineorum sepalis lanceolatis acutis, petalis 0, ovario subgloboso tomentoso, styli ramis brevibus semel dischtomis.

Hab. Madanda forests at about 400 ft.; in fl. Dec.; nn. 1408, 1779.

Folia solemniter 2·5–4 cm. long. (exstant majora fere 6 cm. æquantia necnon minora 2 cm.), 1·8–2·8 (raro 3·5) cm. lat., in sicco utrinque dilute brunneo-viridia; petioli 5–15 mm. long., dense pubescentes. Stipulæ circa 2 mm. long. Racemi summum 3·5 cm. long., sæpius vero breviores; pedunculus 5–15 mm. long., ut rhachis florigera pubescens. Pedicelli florum masculorum circa 2 mm., florum femineorum circa 4 mm. long. Bracteæ circa 1 mm. long. Florum masculorum sepala 1·8 mm., petala 2 mm., filamenta 1·75 mm. long., puberula, antheræ 0·6 mm. long. Florum femineorum sepala sub flore 2 mm. sub fructu maxime crudo 3 mm. long. Ovarium 2 × 1·75 mm. Styli ramuli circa 1·5 mm. long.

Near *C. rivularis*, Müll. Arg., and *C. angolensis,* Müll. Arg. From the former it can be distinguished by the stipitate petiolar glands and the smaller female flowers with narrow calyx-lobes; the latter, of which the female flowers are unknown, besides probably being diœcious, has larger leaves more markedly cordate at the base and larger male flowers.

CROTON (§ Eucroton, Eutropia) GUBOUGA, *S. Moore*, sp. nov.

Arbuscula monoica, ramulis pilis stellatis pubescentibus cito glabris, foliis ovatis vel ovato-oblongis acuminatis basi truncato-rotundatis 3–5-plinervibus margine serrato-crenatis tenuiter membranaceis supra mature glabris subtus intricate griseo-stellato-pubescentibus petiolis quam lamina plane brevioribus gracilibus pubescentibus mox glabrescentibus apice glandulis 2 pedicellatis præditis, stipulis linearibus subscariosis, racemis bisexualibus floribundis floribus 5-meris continuis inferioribus femineis masculis intermixtis superioribus masculis omnibus pedicellatis, florum masculorum sepalis late ovatis obtusis margine ciliatis, petalis late oblongis obtusis sepala paullo excedentibus, staminibus 16–20, receptaculo villosulo, florum femineorum sepalis obovatis obtusissimis margine ciliolatis leviter crassiusculis, petalis 0, ovario subgloboso dense tomentoso, stylis bis dichotomis, capsula late obovoidea 2-loculari pilis stellatis perspicuis plus minus sparsim obsita.

Hab. Lower Umswirizwi River and Sabi River at 1000 ft.; Chibabava, Lower Buzi, at 400 ft.; in fl. Nov.; nn. 153, 1123, 1125.

Folia 5–7 cm. long., 3–4 cm. lat., supra in sicco viridia subtus grisea; costæ utrinque prominulæ; petioli vulgo 1·5–2·5 cm. long. Stipulæ circa 3 mm. long. Racemi summum 6 cm. long., dense pubescentes. Bracteæ parvulæ, subulatæ circa 2 mm. long., ut pedicelli 2–5 mm. long. pubescentes. Florum masculorum sepala 3·5 mm., petala 4 mm., filamenta 2·5 mm., antheræ vix 1 mm. long. Florum femineorum sepala 5 mm. long.; horum glandulæ fere 1 mm. long. Ovarium $4 \times 3{\cdot}5$ mm.; styli ramuli ultimi circa 3 mm. long. Capsula summum $2{\cdot}4 \times 2{\cdot}5$ cm., saltem in sicco compressa. Semina fusca, 12 mm. long.

This looks very like *C. megalobotrys*, Müll. Arg., a diœcious species, of which the female flowers are unknown, with larger male flowers and longer filaments to the stamens. Its affinity is nearest with *C. adenophorus*, Müll. Arg., from Madagascar. It is a small tree of the river banks and open woods; the timber rots rapidly and is useful for firewood. The bark is scraped and the scrapings are thrown into the water to kill fish. Chindao names, "Gubouga" and "Mubouguta."

JATROPHA (§ Tuberosæ) CAMPESTRIS, *S. Moore*, sp. nov.

Herbacea, fere omnino glabra, caule crebro folioso simplici sparsim minute argyreo-purpuraceo leviter vernicoso deinde glabro, foliis breviter petiolatis ambitu late obovatis 5–7-palmato-pinnatifidis segmentis oblongis obtusis margine repandis distanterve denticulatis raro brevissime lobulatis crassiusculis nervis faciei inferiore minute furfuraceis exclusis glabris subtus aliquantulum glaucis, stipulis subulatis vel bifidis circa 1 mm. long. diutule persistentibus, cymis quam folia brevioribus subcongestis multifloris, florum masculorum sepalis ovatis obtusis integris glabris, petalis angustissime obovato-oblongis obtusissimis sepala duplo excedentibus, staminibus 8 filamentis inter se liberis, florum femineorum sepalis iis masculorum similibus, ovario glabro, stylis 3.

Hab. A fair-sized herb not uncommon in the Umswirizwi flats, 1000 ft.; in fl. & fr. Nov.; n. 311.

Folia pleraque 6–8 cm. long., horum segmentum terminale cetera sæpius excedens, segmenta proximalia reducta, segmenta solemniter 4–6·5 × 1–1·3 cm., proximalia dum adsint adusque 3–10 mm. imminuta; petioli crassiusculi, summum 5 mm. long. Cymæ circa 4 × 2·5 cm. Disci glandulæ inter se liberæ, late oblongæ, 1 mm. long. Sepala 3 mm. long. Petala florum masculorum 6 mm., florum femineorum 7 mm. long. Filamenta 3 mm., antheræ 1·2 mm. long. Ovarium subglobosum, 2 mm. long. Capsulæ valvæ 13 mm. long., rugulosæ, brunneæ. Semina caruncula haud exempta 9 mm. long., nigra, dorso linea latissima longitudinali puniceo-badia utrinque notata, caruncula inciso-lobata, fusca.

The affinity is with *J. natalensis*, Müll. Arg., which has a pubescent stem, entire or trifid leaves, and monadelphous stamens.

Cluytia Swynnertonii, *S. Moore*, sp. nov.

Frutex dioicus, frequenter ramosus, ramulis teretibus crispe pubescentibus dein puberulis, foliis petiolatis anguste ovato- vel obovato-oblongis obtusis glandulis pellucidis copiose instructis membranaceis margine planis primo pubescentibus cito utraque facie præsertim vero subtus puberulis in sicco olivaceis vel griseo-viridibus, floribus masculis in axillis superioribus 3–7-nis breviter pedunculatis, horum sepalis obovato-oblongis obtusis extus pubescentibus crista parva instructis, petalis quam sepala paullo brevioribus spathulatis obtusis basi 3–4-glandulosis, floribus femineis solitariis breviter pedunculatis, horum sepalis petalisque inter se fere æquilongis lineari-spathulatis obtusis vel obtusiusculis extus pubescentibus illis glandulis 3 præditis hic eglandulosis, ovario dense griseo-pubescente, stylorum inferne pubescentium ramis bipartitis.

Hab. Chipete and outskirts of Chirinda, 3700–4000 ft.; in fl. May, June, Oct.; nn. 197, 530 *a*, 530 *b*, 530 *c*.

Folia nunc minora, sc. 2–3·5 × 1–1·3 cm., nunc majora 7 × 3 cm. attingentia, omnia pagina inferiore aliquanto glauca; petioli pubescentes, 3–10 mm. long. Flores dilute virides. Florum masculorum pedicelli circa 1 mm. long., pubescentes; horum sepala 2 mm. et petala 1·8 mm. long. Columna staminea 1·5 mm. long., antheræ 0·6 mm. Florum femineorum pedunculi pubescentes, 1·5–4 mm. long. Sepala 3 mm., petala 2·75 mm. long. Ovarium ovoideum, 4·5–5·5 mm., styli rami 1 mm. long., horum crura fere totidem.

Nearest *C. Richardiana*, Müll. Arg., and *C. Jaubertiana*, Müll. Arg.; differing from both in shape of leaf and in the sepals and petals.

Cluytia monticola, *S. Moore*, sp. nov.

Suffrutex caule simplici erecto crebro folioso puberulo dein glabro, foliis subsessilibus ovatis vel suborbicularibus obtusis obtusissimisve basi rotundatis

necnon levissime cordatis margine cartilagineo breviter recurvo exempto planis subtus albo-punctatis membranaceis glabris, floribus masculis in axillis superioribus vel fere omnibus 1–3 pedunculis gracillimis quam flores multo longioribus suffultis, sepalis ovatis obtusis basi glandulis 5 onustis sparsim albo-punctatis, petalis quam sepala paullulum brevioribus obovato-spathulatis basi 3-glandulosis, floribus femineis ignotis.

Hab. Mt. Pene, 6500–7000 ft.; in fl. Sept., Oct.; nn. 2012, 6159.

Planta paullo ultraspithamea. Caulis 1·5–2 mm. diam. Folia 1·2–2·5 × 1–1·5 cm., in sicco virentia, subtus sæpius pallidiora vel etiam subglauca, horum costæ difficile aspectabiles; petioli summum 1·5 mm. long. Pedunculi vulgo 1–1·5 cm. long. Flores albi. Sepala 2·5 × 1·75 mm. Petala 2·25 mm. long. Columna staminea 1·75 mm. long., antheræ ·75 mm. Fem. rudimentum 0·5 mm. ex columna staminea eminens.

At first sight much like *C. cordata*, Bernh., which, among other points, has coriaceous leaves with strong venation.

CLUYTIA STELLEROIDES, *S. Moore*, sp. nov.

Suffrutex caule simplici erecto crebro folioso puberulo dein glabro, foliis anguste obovato-oblongis obtusis basin versus in petiolum brevem angustatis margine cartilagineo leviter recurvis subtus albo-pustulatis firme membranaceis glabris, floribus masculis 2–3-nis sat longe graciliterque pedicellatis, sepalis ovato-oblongis obtusis basi crista 8-glandulosa onustis, petalis quam sepala plane brevioribus rhombeo-ovatis obtusissimis unguiculatis basi 3-glandulosis, floribus femineis haud obviis.

Hab. Northern Melsetter, 5000–6000 ft.; in fl. Oct.; n. 6214.

Caulis ægre 2 mm. diam. Folia 1·5–2 cm. long., 6–8 mm. lat., in sicco virentia, costis sub lente parum aspectabilibus; petioli 2–3 mm. long. Pedicelli ± 8 mm. long. Florum masculorum sepala albo-pustulata, 2·25 mm. long., petala 1·75 mm. Columna staminea 1·5 mm. long., antheræ 0·5 mm. Femineum rudimentum 0·6 mm. ex columna eminens.

Differs from the preceding in the shape of the leaves and the rhombeo-ovate petals.

CLUYTIA PHYLLANTHOIDES, *S. Moore*, sp. nov.

Fruticulus dioicus, ramosus, copiose foliosus, ramulis sparsim puberulis deinde glabris, foliis breviter petiolatis oblongo-obovatis obtusissimis basi obtusis vel subrotundatis tenuiter coriaceis glabris supra viridibus subtus pallidis, floribus masculis in fasciculis axillaribus paucifloris dispositis, sepalis obovato-oblongis obtusissimis crista 2-glandulosa instructis, petalis quam sepala paullulum brevioribus rhombeo-spathulatis unguiculatis basi 2-glandulosis, floribus femineis verisimiliter solitariis, sepalis oblongis obtusis basi 2-glandulosis quam petala oblongo-spathulata obtusissima eglandulosa longioribus.

Hab. Melsetter, 6000 ft.; in fl. Sept.; n. 1722.

Folia epunctata, 1–2 cm. long., 7–14 mm. lat.; petioli 1–2 mm. long., puberuli. Bracteæ parvulæ, puberulæ. Florum masculorum pedicelli circa 1·5 mm. long.; sepala 2·25 mm., petala 2 mm. long., columna staminea 1·5 mm. long., antheræ ovatæ 0·5 mm. long. Florum femineorum sepala (sub fructu) 2·5 mm., petala 2 mm. long. Capsula 4 mm. long.

This is probably near *C. Paxii*, Knauf., of which I have seen no specimen. It is described as having larger leaves, male flowers with obovate sepals provided with a 3-lobed crest and eglandular petals; the female flowers are unknown.

CEPHALOCROTON MOLLIS, *Klotzsch in Peters Mossamb. Bot.* 99, t. 17.

Lower Umswirizwi River, 1000 ft.; in fl. Nov.; n. 309.

Distrib. Zambesia.

ACALYPHA ORNATA, *Hochst. ex A. Rich. Tent. Fl. Abyss.* ii. 247.

Lower Umswirizwi River, 1000 ft.; Boka, Lower Buzi, 100 ft.; Kurumadzi River, Jihu, 2000 ft.; in fl. Nov., Dec.; nn. 796, 797, 798.

Distrib. Tropical Africa except the Upper Guinea Province.

A. VILLICAULIS, *Hochst. l. c.* 248.

Near Chirinda, 3500–4000 ft.; Upper Buzi River, 3000 ft.; in fl. April, May, Dec.; nn. 382, 383, 503, 1153.

Distrib. Eastern tropical Africa, also in Natal and Transvaal.

Grows as a weed in cultivated ground. Chindao name, "Chitambhuru."

ACALYPHA (§ Euacalypha, Pleurostachya) CHIRINDICA, *S. Moore*, sp. nov.

Herbacea, monoica, caule ascendente folioso gracili pubescente, foliis palmatim 5-nervibus ovato-lanceolatis sursum angustatis basi obtusis angusteve rotundatis margine crenato-serratis membranaceis supra pilis strigillosis appressis onustis subtus sparsim piloso-pubescentibus petiolis multo brevioribus insidentibus, spicis masculis axillaribus densifloris foliis brevioribus flore femineo orbis, spica feminea terminali unica cylindrica multiflora, hujus bracteis approximatis 1-floris suborbicularibus ad medium in lacinias 10–12 lineari-lanceolatas acutas divisis hirsutulis, florum femineorum sepalis 3 ovatis quam ovarium albo-hirsutum brevioribus, stylis fere a basi vel saltem dimidio superiore longe lacinuligeris.

Hab. Near Chirinda, 3800 ft.; in fl. Dec.; n. 381.

Folia 3–6 × 1·3–2·7 cm., pagina superiore in sicco brunnescentia, inferiore griseola; petioli ± 1 cm. long., pubescentes; stipulæ anguste lineari-lanceolatæ, acuminatæ, 3–4 mm. long. Spicæ masculæ pedunculo tenui pubescente exempto circa 2·5 × 2 mm. Flores masculi hispiduli. Spica feminea 15 × 6 mm. addito pedunculo pubescente 6 mm. long. Bracteæ femineæ 2·5 × 4 mm. Sepala 0·4 mm. long. Ovarium subglobosum, 1 mm. long. Styli purpurascentes, fere 5 mm. long., horum lacinulæ ± 2 mm. long.

Near *A. villicaulis*, A. Rich., *A. zambesica*, Müll. Arg., and *A. senensis*,

Klotzsch, differing among other features of less importance in the 10–12-laciniate female bracts with linear-lanceolate laciniæ which show little disparity of size among themselves.

A. chirindica is common in cultivated ground.

ACALYPHA PEDUNCULARIS, *Meissn. ex Krauss in Flora*, xxviii. (1845) 82.

Melsetter, 6000 ft.; Upper Buzi River, 3000 ft.; Northern Melsetter, 5000–6000 ft.; in fl. Sept., Oct., Dec.; nn. 739, 2015, 6040, 6227 *a*.

Distrib. South Africa northward to Nyasaland.

A. PUBIFLORA, *Baill. Adansonia*, i. (1860–61) 268.

Boka, Lower Buzi, 100 ft.; in fl. Dec.; nn. 736, 737.

Distrib. Zambesia. Also in Madagascar.

A. INDICA, *Linn. Sp. Pl.* 1003.

Zinyumbo Hills, 1500 ft.; Boka, Lower Buzi, 100 ft.; Northern Melsetter, 2000–6000 ft.; in fl. Jan., April, Dec.; nn. 735, 738, 2014.

Distrib. Tropical and South Africa, Mascarene Islands, East Indies.

A. CILIATA, *Forsk. Fl. Ægypt.-Arab.* 162.

Outskirts of Chirinda, 3700–4000 ft.; in fl. June; n. 734.

Distrib. Tropical Africa, Arabia, India.

ACALYPHA (§ Euacalypha, Pleurostachya) SWYNNERTONII, *S. Moore*, sp. nov.

Suffrutex monoicus, ramosus, caule valido dein glabro necnon cortice griseo-purpureo circumdato, ramulis foliosis griseo-pubescentibus, foliis sat longe petiolatis 5-nervibus ovatis vel ovato-lanceolatis apice caudato-acuminatis basi obtusissimis margine serratis membranaceis supra pilis strigillosis appressis sparsim præditis subtus in nervis hirsutulis, spicis masculis floribus femineis orbis axillaribus breviter pedunculatis densifloris tenuibus, spica feminea unica terminali cylindrica quam masculæ paullo latiore apice flores paucos masculos gerente, bracteis femineis approximatis unifloris parvulis suborbicularibus ore circa 20-dentatis dentibus parvis inter se æqualibus addito lobo intermedio anguste lineari quam bractea ipsa parum breviore, sepalis 3 ovato-lanceolatis ovarium albo-hirsutum excedentibus, stylis a basi lacinuligeris.

Hab. Chibabava, Lower Buzi, 400 ft.; in fl. Dec.; n. 799.

Folia vulgo 4–5·5 × 1·5–2·2 cm., pagina superiore in sicco olivacea, inferiore grisea; petioli ± 2 cm. long., tenues, pubescentes. Stipulæ setaceæ, circa 2 mm. long. Spicæ masculæ (incluso pedunculo pubescente 2 mm. æquante) 2–4 cm. long., 2 mm. lat. Spica feminea 4 cm. long., 3 mm. lat.; hujus bracteæ 2·75 × 2 mm. (lamina 1·5 mm., lobus intermedius 1·25 mm.). Sepala 1 mm. long. Ovarium 0·6 mm. long. Styli circa 5 mm. long., lacinulæ 3–4·5 mm.

The affinity of this seems to be with *A. Lindheimeri*, Müll. Arg., from Texas, but there are too many points of difference to render their mention necessary.

NEOBOUTONIA MELLERI, *Prain, MSS.*, comb. nov.

Mallotus Melleri, Müll. Arg. in Flora, xlvii. (1864) 468.

Mount Maruma, 3500 ft.; Kurumadzi River, Jihu, 2000 ft.; in fl. (♂) Sept., Nov.; nn. 686, 1124.

Distrib. Zambesia.

A large tree with bright or pale yellow flowers. Timber rather soft and wet. Yields a latex apparently containing rubber.

ARGOMUELLERA MACROPHYLLA, *Pax, in Engl. Bot. Jahrb.* xix. (1894) 90.

Chirinda Forest, 3700–4000 ft.; in fl. May, Oct., Nov.; nn. 114, 114 *a*, 114 *b*. An evergreen shrub very common in the forest.

MACARANGA MELLIFERA, *Prain*, sp. nov.

Arbor majuscula, ramis patentibus in comam latiusculam expansis, ramulis primum parce puberulis mox glabrescentibus robustis. *Folia* petiolata, ovata vel oblonga, acute acuminata, basi late abrupte cuneata vel rotundata, margine integra, 10–12 cm. longa, 6–7 cm. lata, primum membranacea, matura subcoriacea, basi distincte 3-nervia, nervo mediano utrinque, nervis lateralibus marginem versus nervos secundarios 5–6 emittentibus, supra glaberrima subtus copiose glanduloso-punctata sed nisi secus nervi mediani dimidium basale nervorumque basalium lateralium trientes basales pilis longiusculis subpatentibus densius obsita glabra; petiolus 4–5 cm. longus; stipulæ late lanceolatæ, puberulæ, deciduæ. *Flores masculi* in paniculas axillares versus ramulorum apices dispositi; rhachis 4–5 cm. longa cum ramulis 1 cm. longis puberula; bracteæ parvulæ, ovatæ, acutæ, integræ, glomerulos subtendentes. *Calyx* membranaceus, clausus, in alabastro globosus, per anthesin valvatim 3–4-fidus. *Stamina* 15 filamentis in receptaculo angusto elongato insertis ideoque columnam centralem simulantibus; antheræ terminales loculis apice dehiscentibus, anthera aperta hinc cruciatim 4-valvata. *Discus* 0. *Ovarii rudimentum* 0. *Flores feminei* in racemos axillares 2–3 cm. longos dispositi; bracteæ ovatæ, acutæ, integræ, parvulæ, pedicellos singulos vel glomeratos 2 mm. longos subtendentes. *Calyx* fere membranaceus, per anthesin subtruncatus. *Discus* 0. *Ovarium* abortu 1-loculare, apice styli ramo singulo patente-erecto crassiusculo coronatum, lateribus styli ramis duobus rudimentariis munitum, dense lepidotum. *Fructus* ignotus.

Hab. Chirinda outskirts, 3700–4000 ft.; in fl. Oct.; nn. 5, 2120. Mt. Pene, 7000 ft.; in fl. Oct.; n. 6039 and most probably n. 1122 in bud only.

Noted as a fairly large tree, comparatively low and wide branching, with honey-scented flowers which are very attractive to Hymenoptera. The species also occurs in Nyasaland, where it was collected by Mr. J. Buchanan in 1901 (*Buchanan*, 1483). [D. PRAIN.]

GELONIUM PROCERUM, *Prain, Kew Bull.* 1911, *ined.*

Arbor dioica, glabra, ramulis ultimis teretibus crebro foliosis, foliis alternis

oblongo-oblanceolatis vel ellipticis sub apice sæpe attenuatis obtusis basi in petiolum brevem gradatim extenuatis margine integris raro undulato-dentatis tenuiter coriaceis utrinque nitidulis inter maculas reticuli satis prominentis pustulatis nonnunquam vero planis in sicco viridibus, stipulis parvulis ovatis acutis, florum masculorum fasciculis sessilibus paucifloris floribus femineis solitariis pedicellatis, florum masculorum sepalis 6 ovatis obtusissimis, staminibus 20–22, florum femineorum sepalis 6 ovato-oblongis oblongisve obtusis, staminodiis circa 10 filiformibus, ovario trigono-subgloboso 2–3-loculo, stylis 2–3 subintegris vel bifidis.

Hab. Chirinda Forest, 3700–4000 ft.; Chimanimani Mountains at 7000 ft.; in fl. Oct.; nn. 104, 1115.

Folia pleraque 8–10 cm. long., 3–4 cm. lat., exstant minora sc. 5×2 cm., necnon majora raro $12 \times 5{\cdot}5$ cm. attingentia. Stipulæ circa 1·5 mm. long. Et foliorum et florum gemmæ resinosæ. Florum masculorum sepala 3 mm. long. Filamenta 1 mm., antheræ fere 2 mm. long. Florum femineorum pedicelli crassi, 3 mm. long. Sepala exteriora $3 \times 2{\cdot}25$ mm., interiora $3 \times 1{\cdot}25$ mm. Staminodia fere 1 mm. long. Ovarium 2×2 mm. Capsula globosa, obscure verruculata, circa 7 mm. long.

A middle-sized tree with yellow flowers.

Specimens at Kew apparently similar to Mr. Swynnerton's are named "*G. Zanzibarense*, Müll. Arg.," a species the type of which I have not seen. Mr. Swynnerton's specimens cannot be referred to that species as it is monœcious and its male flowers have only 6–12 stamens. The nearest affinity seems to be with *G. Boivinianum*, Müll. Arg., from Madagascar, of which the flowers are unknown.

The hexamery of both male and female perianth is worth mention. I am not sure whether all the male flowers have staminodes; some of those examined certainly had not, though the staminodes might have got detached or been eaten by insects.

TRAGIA (Tagira) AMBIGUA, *S. Moore*, sp. nov.

T. caule volubili sparsim pubescente ramulos frequenter foliosos subdistantes emittente, foliis sat longipetiolatis ovatis vel ovato-oblongis acuminatis basi cordatis margine crebro dentato-serratis 5-nervibus utrinsecus pilis innocuis puberulis sparsimve pubescentibus, racemis pedunculatis paucifloris flore infimo femineo reliquis masculis, flore femineo bractea comparate magna suborbiculari grosse dentata, florum masculorum pedicellatorum bracteis lineari-lanceolatis acutis extus sparsim pubescentibus, floris masculi calyce 3-partito segmentis late ovatis obtusis, staminibus 2–3 antheris introrsis, floris feminei calycis dense hispidi laciniis 6 utrinque 8–10-lacinulatis sub fructu ampliatis rhachi lanceolata lacinulis linearibus integris, ovario 3-mero hispido, stylis validis inferne connatis.

Hab. Chirinda Forest, 3700–4000 ft.; in fl. June; n. 795.

Folia summum 6×4 cm., modice equidem $\pm 4 \times 2$ cm., supra in sicco fusca

subtus viridi-grisea; petioli 5–20 mm. long., sparsim pubescentes. Stipulæ lineari-lanceolatæ, circa 4 mm. long., extus pubescentes intus glabræ necnon subcastaneæ. Racemi (incluso pedunculo) 1·5–3 cm. long. Floris feminei bractea viridis, 3 × 4·5 mm.; florum masculorum bracteæ 2 mm. long., pedicelli circiter totidem. Horum sepala 1·25 mm. long. Antherarum loculi 0·3 mm. long. Floris feminei calycis segmenta sub flore 2 mm. long. (sub fructu vix 1 cm. long.), 1·2 mm. lat.; lacinulæ 0·4 mm. long. Ovarium cum stylorum basi indivisa 1·3 mm. long.; stylorum pars libera extus pubescens, 1·25 mm. long.; stigmata recurva.

Var. URTICANS, *S. Moore*, var. nov. Primo obtuto a typo secernenda propter caulem foliaque majora longius petiolata pilis urticantibus obsita. Folia 7·5–10 cm. longa, 3·5–6 cm. lata; petioli crassiusculi, 2·5–8 cm. longi.

Hab. ut supra; in fl. May; n. 446.

This differs from its nearest allies *T. mitis*, Hochst., and *T. natalensis*, Sond., chiefly in the bracts, those subtending the *female* flowers of *T. ambigua* being large like *all* the bracts of *T. natalensis*, while its male bracts are narrow like those subtending *all* the flowers of *T. mitis*.

TRAGIA (Tagira) MADANDENSIS, *S. Moore*, sp. nov.

T. caule volubili pube brevi subsparsa pilis paucis hispidis intermixta obtecto, foliis longipetiolatis ambitu late ovatis 3-lobis basi truncatis 5-nervibus margine crenato-serratis utrinque præsertim ad nervos hispidis hispidulo-puberulisve, stipulis rhombeo-lanceolatis satis perspicuis, racemis pedunculatis paucifloris floribus 2 infimis femineis ceteris masculis, pedunculis hispidis, utriusque secus florum bracteis parvis ovatis florum femineorum 2–3-partitis vel 2–3-fidis masculorum integris acuminatis omnibus minute hispidulis, floribus masculis breviter pedicellatis horum calyce 3-partito segmentis late ovatis obtusis, staminibus 3 inter se liberis, antheris introrsis, florum femineorum calycis hispidi laciniis 6 utrinque 2–3-lacinulatis rhachi oblonga lacinulis sæpius anguste lineari-lanceolatis integris vel basi latere uno vel utrovis lobulum ferentibus, ovario 3-mero sursum hispido, stylis in columnam ovario æquilongam inferne coalitis.

Hab. Madanda forests at about 400 ft.; in fl. Dec.; n. 794.

Folia adulta 5 cm. long., juxta basin totidem lat., subtus in sicco pallidiora. Stipulæ circa 5 mm. long. Racemi (pedunculo incluso) summum 2 cm long. Florum femineorum bracteæ circa 3–3·5 × 2–2·5 mm.; florum masculorum bractea 2·5 × 1·5 mm. Florum masculorum sepala 1 mm. long.; antheræ 0·3 mm. long. Floris feminei calycis laciniæ sub flore 3 mm. long., cito usque ad 5 mm., augmentatæ, hujus rhachis primo 0·3 mm. cito 1 mm. lat.; lacinulæ 1 mm. long., cito summum 2–2·5 × 0·5–0·75 mm. Ovarium mox 2·5 mm. long., styli rami 2 mm.

Easily to be distinguished from *T. cordifolia*, Benth., and its allies by the leaves and bracts of the female flowers with comparatively broad (not narrowly linear) lacinulæ and a broad rhachis.

MAPROUNEA AFRICANA, *Müll. Arg. in DC. Prod.* xv. II. 1191.
Open woods at Beira; in fr. Dec.; nn. 1503, 1734.
Distrib. Tropical West Africa.

SAPIUM MANNIANUM, *Hiern in Cat. Welw. Pl.* i. 986.
Chipete Forest Patch, 3800 ft.; Mt. Maruma, 3500 ft.; near Chirinda, 3800 ft.; in fl. March, April, June, Sept.; nn. 103, 741, 742.
Distrib. Tropical Africa.

EXCŒCARIA SYLVESTRIS, *S. Moore*, sp. nov.
Frutex elatus, monoicus, glaber, foliis plerisque oppositis (paucis suboppositis) lanceolatis vel lanceolato-ovatis rarius ovato- vel obovato-oblongis sub apice sæpe attenuatis apice ipso obtusis raro obtusissimis in petiolum brevem eglandulosum gradatim extenuatis integris tenuiter coriaceis glandulis destitutis, stipulis late ovatis acuminatis margine ciliatis, spicis terminalibus axillaribusve foliis brevioribus floribus 1 vel 2 infimis femineis, bracteis subreniformibus obtusissimis ciliolatis basi utrinque glandula instructis quam bracteolæ subulatæ acuminatæ brevioribus, florum masculorum pro bractea unicorum sepalis 3 inter se liberis lanceolatis acutis, staminibus 3, filamentis liberis, florum femineorum sepalis ovatis acutis obtusisve intus eglandulosis margine ciliatis, ovario ovoideo sepalis æquilongo glabro.
Hab. Chirinda Forest, 3700–4000 ft.; in fl. Oct., Jan.; n. 72, 72*a*.
Folia summum 14 × 5 cm., pleraque 7–12 × 2·5–4 cm., in sicco plus minus viridia, pagina superiore sæpe olivacea, inferiore pallidiora, statu juvenili intense rubra, nitida, costulæ numerosæ angulo recto vel fere recto costæ centrali insertæ, ut reticulum satis laxum utrinsecus prominulæ; petioli crassiusculi, canaliculati, ±5 mm. long. Stipulæ circa 3·5 mm. long. Spicæ profecto evolutæ (incluso pedunculo circa 7 mm. long.) usque ad 3 cm. long. Bracteæ 1 × 1·5 mm.; bracteolæ 1·5 mm. long. Florum masculorum sepala 0·75 mm. long. Filamenta crassiuscula, 0·65 mm, long.; antheræ reniformes, loculi 0·5 mm. long. Florum femineorum sepala 1·5 mm. long. Ovarium 1·5 × 1·75 mm., styli 3, arcte involuti. Capsula trigono-subglobosa, matura fere 1 cm. diam. Semina 4 mm. diam.
Known by the large opposite eglandular leaves, the very obtuse bracts and the subulate bracteoles.
A large handsome evergreen shrub 15–20 feet high. It yields a milky latex apparently containing rubber, which flows fairly freely from the twigs, but is scanty in old stems.

URTICACEÆ.

CELTIS DIOICA, *S. Moore*, sp. nov.
Arbor excelsa, dioica, novellis pubescentibus, foliis adhuc valde juvenilibus petiolatis ovato-lanceolatis acuminatis basi acutis integris trinervibus membranaceis glabris, stipulis lanceolatis acutis vel acuminatis subscariosis dorso puberulis margine ciliatis, floribus utriusque sexus præcocibus masculis in paniculis brevibus plurifloris digestis femineis ex axillis ramulorum adhuc

perbrevium 2–3 (raro solitatim) oriundis, florum masculorum sepalis 5 basi leviter sagittatis, disco piloso, florum femineorum sepalis masculis similibus, ovario calycem plane excedente oblongo-ovoideo glabro, styli ramis indivisis perspicue stigmatosis.

Hab. Chirinda Forest, 3700–4000 ft.; in fl. Oct.; n. 108.

Folia cruda summum 35 × 8 mm.; costæ ordinis secundi utrinque 2–4; petioli 4–5 mm. long. Stipulæ circa 4 mm. long. Paniculæ masculæ summum 1 cm. long.; pedicelli ±2 mm. long. Sepala circa 1·5 mm. long., erecta. Filamenta 2 mm., antheræ 1·5 mm. long. Ovarium vix 2 mm. cito 3 mm. long., in sicco fuscum; styli rami 2 mm. long., sursum gradatim attenuati. Drupa ovoidea, flava, 6 mm. long.

One of the largest forest trees with somewhat rough bark and whitish timber with a most offensive smell, bored to a certain extent by *Bostrychidæ*. The small yellow berries form the staple food of the forest birds.

Besides the specimens showing flowers and in some cases young leaves, there is a small one in the collection of fruits with apparently adult leaves very little larger than those described above: perhaps these small leaves are characteristic of the species, which can be known by the diœcism and the paniculate male inflorescences.

TREMA GUINEENSIS, *Priemer in Engl. Bot. Jahrb.* xvii. (1893) 426.

Near Chirinda, 3800 ft.; Kurumadzi River, Jihu; Mt. Maruma, 3500 ft.; open woods at Beira; in fl. April, Sept., Nov., Dec.; nn. 129, 1103, 1104, 1106, 1388.

Distrib. Tropical and South Africa; Mascarene Islands.

FICUS EXASPERATA, *Vahl, Enum.* ii. 97.

Kurumadzi River, Jihu, 2000 ft.; Chikambogé Valley, 3000 ft.; Chirinda Forest, 3700–4000 ft.; fl. & fr. Aug.–Oct.; nn. 437, 437 *a*, 437 *b*, 601.

Distrib. Tropical Africa.

A large tree: the leaves are used by the natives as sand-paper. Singuni name, "Umfubu"; Chindao, "Mufubu."

N. 437 *c* from Chikambogé Valley should most probably be referred here. The specimen, without flowers or fruit, has larger leaves than ordinary, somewhat thinner in texture and drying greener. It has counterparts in Herb. Kew in two specimens collected by Dr. Kirk at Zanzibar, where, as the note informs us, the leaves are used for polishing sticks.

F. CAPREÆFOLIA, *Del. in Ann. Sci. Nat.* sér. 2, *Bot.* xx. (1843) 94.

Madanda forests at about 400 ft.; Chibabava, Lower Buzi, 400 ft.; Sabi River at about 1000 ft.; in fr. Nov., Dec.; nn. 1004, 1100, 1101.

Distrib. Tropical East Africa.

Leaves used as sand-paper for polishing assegai-handles. Chindao name, "Umbharanta."

FICUS CAPENSIS, *Thunb. Ficus Diss.* 13.
Chirinda Forest, 3700–4000 ft. ; in early fr. June ; n. 434.
Distrib. Tropical and South Africa.
A large tree with edible figs and milky latex. Chindao name, "Muckowana."

F. SUBCALCARATA, *Warb. & Schweinf. in Engl. Bot. Jahrb.* xx. (1892) 155.
Chikambogé Valley, 3000 fr. ; in fr. Sept. ; n. 435.
Distrib. Tropical East Africa.
A very large tree with shady spreading crown and milky latex coagulating into a substance like papier-maché. Chindao name, "Mutowe-towe."
Other specimens belonging to this genus are reserved for further examination.

BOSQUIEA PHOBEROS, *Baill. Adansonia*, viii. (1867) 72.
Maruma forest patch, 3700 ft. ; in fl. Sept. ; n. 687.
Distrib. Tropical East Africa.
A large tree up to 80 feet, yielding fairly freely an ochreous-yellow latex.

MYRIANTHUS ARBOREUS, *Beauv. Fl. Owar.* i. 16.
Chirinda Forest, 3700–4000 ft. ; Mt. Pene Forest, 6500–7000 ft. ; in fl. Sept., Oct., Dec. ; nn. 111, 111 *a*, 1052.
Distrib. Tropical Africa.
A very large tree in Chirinda, but stunted on Mt. Pene.

FLEURYA CAPENSIS, *Wedd. in Ann. Sci. Nat.* sér. 4, *Bot.* i. (1854) 183.
Chirinda Forest, 3700–4000 ft. ; commonest in damp soil along the upper Zona ; in fl. April, in fr. May ; nn. 338, 793.
Distrib. South Africa.

URERA OBOVATA, *Benth. in Hook. Niger Fl.* 516.
Chirinda Forest, 3700–4000 ft. ; in fl. Jan. ; n. 1518.
Distrib. Tropical Africa.

MYRICACEÆ.

MYRICA PILULIFERA, *Rendle in Trans. Linn. Soc.* ser. 2, *Bot.* iv. (1894) 43.
Mt. Pene at 6500 ft. ; in fl. July, in fr. Sept. ; nn. 530, 1735.
Distrib. Nyasaland.

Var. PUBERULA, *Rendle in Journ. Bot.* xli. (1903) 86.
Melsetter, 6000 ft. ; Nyahodi River at 5500 ft. ; Mt. Pene at 7000 ft. ; in fr. Sept., Oct. ; nn. 610, 610 *a*, 623, 6084.
Distrib. Nyasaland.
N. 1735, from the neighbourhood of Chirinda at 3500 feet, is apparently the male form of this species.

MONOCOTYLEDONS.

By Dr. A. B. Rendle.

HYDROCHARIDEÆ.

Ottelia lancifolia, *Rich. Tent. Fl. Abyss.* ii. 280.

Inyamadzi Valley, 2500 ft. ; growing at the bottom of the river; in fl. Sept.; n. 781.

Distrib. East tropical Africa, Angola.

ORCHIDACEÆ.

Eulophia milanjiana, *Rendle in Trans. Linn. Soc.* ser. 2, *Bot.* iv. (1894) 44.

Near Chirinda, 3800 ft.; in fl. Oct.; n. 328.

Distrib. German East Africa to Gazaland.

Lissochilus papilionaceus, *Rendle in Journ. Bot.* xxxiii. (1896) 170.

Near Chirinda, 3700 ft. ; in fl. March ; n. 227.

Distrib. British Central Africa, Stevenson Road, 4000–5000 ft.

L. Krebsii, *Reichenb. f. in Linnæa,* xx. (1847) 685.

Kurumadzi River, Jihu, 2000 ft. ; in fl. Nov. ; n. 747.

Distrib. Mt. Milanji and Morambala Mts. ; also South Africa.

L. arenarius, *Lindl. in Journ. Linn. Soc.* vi. (1862) 133.

Near Chirinda, 3500 ft. ; in fl. Nov. ; n. 751. Madanda forests, about 400 ft.; in fl. Dec. ; n. 733.

Distrib. Widely diffused in Tropical Africa ; Natal.

Ansellia humilis, *Bull, Cat.* 1891, 3.

Inyamadzi Valley, 2500 ft. ; in fl. & fr. Oct. ; n. 746.

Distrib. Lower Zambesi.

Eulophia Swynnertonii, *Rendle*, sp. nov.

Herba glabra foliis . . . . , scapo sparse vaginato, vaginis brevibus acuminatis ; racemo laxiter 6–9-floro; bracteis ovato-lanceolatis, acuminatis, pedicellis subæqualibus ; floribus sepalo dorsali oblongo apiculato, sepalis lateralibus brevioribus ellipticis; petalis ellipticis sepalum dorsale paullo excedentibus; labello trilobo, lobo mediano late oblongo superne rotundato, lobis lateralibus minoribus rotundatis, disco callis tribus parallelis lineato, calcare brevi conico ; columna clavata.

Hab. Mt. Pene, 6500–7000 ft.; in fl. Sept. and Oct. ; nn. 752, 6050. Common on the higher grass-covered slopes ; flowers yellow- and brown-madder.

Scapus cum racemo 30–50 cm. long., ad 4 mm. crass. ; vaginæ siccæ scariosæ, supra basin 2 vel 3, infima 4 cm. long. Racemus 8–15 cm. long. ;

bracteæ ad 1·5 cm. long. Sepalum dorsale 16 mm. long., 4 mm. lat.; sepala lateralia vix 13 mm. long.; petala 18 mm. long., 8 mm. lat.; labellum 16 mm. long.; lobus medianus 7 mm. lat.; lobi laterales vix 3 mm. long.; calcar 4–5 mm. long.; columna 5 mm. long.

Allied to *E. manganjensis*, Rolfe, from the Shiré Highlands, but the long imbricating white sheaths which clothe the scape in that species are represented only by a few distant sheaths; the flowers are also larger in the plant from Mt. Pene.

Angræcum rhodesianum, *Rendle*, sp. nov.

Planta in *Brachystegia Randii* epiphytica habitu *A. bicaudatæ*, caule robusto radices crassas et folia disticha gerente; foliis linearibus complicatis apice inæqualiter bilobatis, vaginis caulem arcte involventibus et velut racemorum pedunculis diu persistentibus; racemis axillaribus e basi multifloris; bracteis brevibus truncatis amplexicaulibus; floribus breviter pedicellatis; sepalis breviter caudatis, lateralibus semiovatis 5-nerviis, dorsali anguste triangulari 4-nervio; petalis sepalis æquilongis, anguste triangulari-lanceolatis, apice breviter caudatis; labello e basi obtuse auriculata late oblongo, supra medium trilobato, lobo medio anguste triangulari-acuminato, lobis lateralibus subrhomboideis emarginatis, calcare subfiliformi; columna brevi crassa; capsula ellipsoideo-obovoidea.

Hab. Melsetter, 6000 ft.; in fr. Sept.; n. 755.

Caulis vix 10 cm. long., pars inferior 3–4 mm. crassus, inferne radicibus crassis et pedunculorum vestigiis suffultus, superne vaginis persistentibus 8 mm. long dense indutus. Folia circa 10 cm. long., 5 cm. lat. Racemi frutescentes 15 cm. long, bracteæ ad 30, 1·5 mm. long. Sepalum dorsale 7·5 mm. long., 2 mm. lat., sepala lateralia 7 mm. long., 2·5 mm. lat., petala 7 mm. long., 1·5 mm. lat., labellum 9 mm. long., pars inferior 2 mm. lat., lobus medius 3·5 mm., lobi laterales 1·5 mm. long.; calcar 11·5 long.; columna 1 mm. long.

Near the South African *A. bicaudatum*, Lindl., and the small group of tropical African species with a similar habit. Perhaps most closely allied to *A. tridactylites*, Rolfe, but a plant of more stunted growth and differing in the character of the lip, which has short blunt, not long slender pointed, side lobes.

Brachycorythis acutiloba, *Rendle*, sp. nov.

Herba sesquipedalis caule paullo supra basin laxe vaginato deinde usque ad racemum foliato, superne præcipue inter flores furfuraceo; foliis circa 20 parvis lanceolatis acuminatis glabris superne in bracteas transgredientibus; racemo densius multifloro; bracteis foliis similibus sed minoribus ovario cum pedicello subæqualibus; floribus pro genere inter majores, sepalis trinerviis, sepalo dorsali obtuse ovato concavo, sepalis lateralibus majoribus valde obliquis semi-ovatis, latere posteriore recto, apiculatis; petalis oblique subovatis basi lateraliter ad

columnam brevem adnatis, margine undulato; labello cum basi cymbiformi in medio perforato, limbo flabelliformi cum nervo mediano crasso apice trilobato, lobo mediano brevi rotundato, lobis lateralibus subfalcatis acutis supra lobum medianum convergentibus.

Hab. Near Chirinda, 3800 ft.; in fl. Dec.; n. 6632. A common ground orchid.

Folia basalia 4·5 cm. long., 1·3 cm. lat., superiora gradatim minora. Bracteæ inferiores 2·5 cm. long., vix 5 mm. lat. Sepalum dorsale 6·5 mm. long., 3·5 mm. lat.; sepala lateralia 1 cm. long., 4·2 mm. lat.; petala 6·5 mm. long., vix 3 mm. lat.; labelli basis 6 mm. long., limbus 9 mm. long., 6·5 mm. lat.; lobus medius 1·25 mm. lat.; lobi laterales 2·4 mm. long.; columna 1·5 mm. long.

Near *B. Welwitschii*, Reichenb. f., which it closely resembles in the flower, but in *Welwitschii* the lateral lobes of the lip are rounded and crenulate. The stem of *B. acutiloba* is somewhat slenderer and the leaves narrower and more sharply acuminate than in the Angolan species. The slit-like perforation in the middle line of the cymbiform base of the lip is an interesting character.

HABENARIA PEDICELLARIS, *Reichenb. f. Otia Bot. Hamb.* ii. 100.
Upper Buzi, 3000 ft.; in fl. April; n. 744.
Distrib. Abyssinia, Mt. Kilimanjaro.

SATYRIUM BUCHANANII, *Schlechter in Engl. Jahrb.* xxiv. (1898) 422.
Lusitu River, hills at 5000 ft.; in fl. April; n. 754.
Distrib. Nyasaland.

S. SPECIOSUM, *Rolfe in Fl. Trop. Afr.* vii. 574 & 270.
Near Chirinda, 3800 ft.; in fl. Dec.; n. 331: Upper Buzi, 3000 ft.; in fl. Apr.; n. 745.
Distrib. Nyasaland, Zambesiland.

S. OCCULTUM, *Rolfe in Fl. Trop. Afr.* vii. 273.
Near Chirinda, 3800 ft.; in fl. Jan.; n. 750.
Distrib. Nyasaland.

DISA HAMATOPETALA, *Rendle in Trans. Linn. Soc.* ser. 2, *Bot.* iv. (1894) 47.
Mt. Pene, 6500–7000 ft.; in fl. & fr. Sept.; n. 753.
Distrib. Nyasaland.

CANNACEÆ.

CANNA ORIENTALIS, *Rosc. Scit.* t. 12.
Near Chirinda, 3800 ft.; in fl. March; n. 398.
Distrib. Tropical Africa and Natal; also Tropical Asia.

ZINGIBERACEÆ.

Kæmpfera rosea, *Baker in Fl. Trop. Afr.* vii. 295.
Beira, open woods, 50 ft.; in fl. Dec.; n. 726.
Distrib. East tropical Africa.

K. Ceciliæ, *N. E. Br. in Kew Bull.* 1906, 169.
Beira, open woods, 50 ft.; in fl. Dec.; nn. 727, 730.
Distrib. Portuguese East Africa.

IRIDACEÆ.

Moræa iridioides, *Linn. Mant.* 28.
Chirinda Forest, 3700–4000 ft.; in fl. & fr. Oct.–Dec.; nn. 399, 6508: Mt. Pene, 7000 ft.; in fl. Oct.; n. 6067.
Distrib. German East Africa, Nyasaland, and widely spread in South Africa.

Aristea zombensis, *Baker in Fl. Trop. Afr.* vii. 346.
Chirinda Forest, 3700–4000 ft.; in fr. Oct.; n. 399 *a*: Chipete outskirts, 3800 ft.; in fr. Apr.; n. 399.
Distrib. Nyasaland.

A. compressa, *Buching ex Baker l. c.* 111.
North Melsetter, Moodie's Nek, 6000 ft.; in fl. & fr. Oct.; n. 6060.
Distrib. Eastern South Africa and Transvaal.

Dierama pendula, *Baker in Journ. Linn. Soc., Bot.* xvi. (1877) 99.
Melsetter, 6000 ft.; in fl. Oct.; nn. 6064, 6065.
Distrib. East tropical Africa; South Africa.

Lapeyrousia erythrantha, *Baker, l. c.* 155.
Mt. Singuno, Jihu, 2000 ft.; in fl. Nov.; n. 776.
Distrib. South tropical Africa.

Crocosma aurea, *Planch. in Flore des Serres*, vii. (1851) 161, t. 702.
Near Chirinda, 3600 ft.; in fl. March; n. 323.
Distrib. German to Portuguese East Africa; South Africa.

Gladiolus gazensis, *Rendle*, sp. nov.
Planta habitu *G. Oatesii* cormo . . . .; caule tenui terete vaginis subfoliaceis superne acutis tecto interdum ramoso, foliis anguste linearibus; spicis multifloris secundis, spathæ valvis siccis membranaceis rubro-brunneis elliptico-oblongis obtusis apiculatis; floribus roseo-purpureis parvis; perianthii tubo brevi tenui curvato, segmentis superioribus apice rotundatis apiculatis unguiculatis mediano obovato lateralibus ovatis, segmentis

inferioribus longe et tenuiter unguiculatis apice obscure apiculatis, mediano obovato, lateralibus brevioribus ellipsoideo-ovatis; staminibus segmenta superiora haud æquantibus, antheris linearibus quam filamenta brevioribus.

Hab. Melsetter, 6000 ft.; Chirinda outskirts, 3700–4000 ft.; Mt. Pene, 6500–7000 ft.; in fl. Sept.; n. 779.

Folium (unum solum exstat) 2·5 mm. lat. Caulis florens ad 4 dm. long.; spica ad 25 cm. long. Spathæ valva exterior 1–1·2 cm. long. Perianthium 2·5–2·7 cm. long.; tubus circa 8 mm. long., lobus superior circa 2 cm. long., lobi laterales superiores paullo breviores, et lobum inferiorem subæquantes, laterales inferiores circa 1·4 cm. long. Stamina 1·6 cm. long.; antheræ 7 cm. long.

Near *G. Oatesii*, Rolfe, but distinguished at once by the colour of the flower and the blunt spathe-valves.

AMARYLLIDACEÆ.

HYPOXIS ANGUSTIFOLIA, *Lam. Encyc.* iii. 182.

Lower Umswirizwi River, 1000 ft.; in fl. Nov.; n. 771.

Distrib. Tropical and South Africa.

H. VILLOSA, *Linn. f. Suppl.* 198.

Northern Melsetter, 5000–6000 ft.; in fl. Oct.; n. 6215: Mt. Pene, 6000–7000 ft.; in fl. Sept. and Oct.; nn. 770, 6082, 6204: near Chirinda, 3800 ft.; in fl. May, Oct.; n. 332.

Distrib. Tropical and South Africa.

CYRTANTHUS RHODESIANUS, *Rendle*, sp. nov.

Herba semipedalis e bulbo infra collum globoso orta, squamis bulbi papyraceis; foliis . . . .; pedunculo sicco complanato; floribus tribus læte rubris umbellatis demum pendulis, spathæ valvis 2 lanceolatis læte rubris; pedicellis tenuibus; perianthii tubo elongato gracili superne sensim ampliato, segmentis tubo circa $\frac{1}{4}$ brevioribus, anguste ovalibus tribus externis internis angustioribus; staminibus biseriatis filamentis brevibus e perianthii fauce exsertis, antheris flavis oblongis; stylo perianthio subæquante, stigmate trifido.

Hab. Chimanimani Mts., 7000 ft.; in fl. Sept., Oct.; n. 769. Common amongst short grass; flowers bright red.

Bulbus 1·5–2 cm. diametro. Pedunculus 10 cm. long. Spathæ valvis vix 3 cm. long.; flores 4–5 cm. long., pedicelli ad 1·5 cm. long. Perianthium 3·5–4·5 cm. long., fauce 4 mm. diam., segmenta circa 1 cm. long.; filamenta 3–3·5 cm. long.; antheræ vix 2 mm. long.

Near *C. Welwitschii*, Hiern, but a much smaller plant with no leaves in the flowering stage. The flowers are relatively larger, with shorter pedicels and a narrower tube.

HÆMANTHUS MULTIFLORUS, *Martyn, Monogr.*
Near Chirinda, 3800 ft.; in fl. Oct.; n. 359.
Distrib. Tropical Africa.

CRINUM KIRKII, *Baker in Bot. Mag.* t. 6512.
Kurumadzi River, 2000 ft.; in fl. Nov.; and near Chirinda, 3800 ft.; n. 438.
Distrib. East tropical Africa.

PANCRATIUM TRIANTHUM, *Herb. in Ann. Nat. Hist.* ser. 1, iv. (1840) 28.
Near Chirinda, 3800 ft.; n. 322.
Distrib. Tropical Africa.

DIOSCOREACEÆ.

DIOSCOREA SATIVA, *Linn. Sp. Pl.* 1033.
Chirinda Forest, 3800 ft.; in fl. May; n. 531.
Distrib. Widely cultivated in the tropics.

D. BUCHANANI, *Benth. in Hook. Ic.* t. 1397–8.
Near Chirinda, 3800 ft.; in fl. July; n. 1091.
Distrib. Shire Highlands.

D. SCHIMPERIANA, *Hochst. ex Kunth, Enum. Pl.* v. 339.
Chirinda, 3700–4000 fl.; in fl. & fr. Feb.; n. 214.
Distrib. Tropical Africa.
Chindao name, "Intendene." Very common along the outskirts of Chirinda and Chipete and found throughout the Jihu, where it seems to prefer the denser bush, as also about Maruma.

D. DUMETORUM, *Pax in Engl. & Prantl, Pflanzenfam.* ii. Abt. 5, 134.
Lower Zona, Jihu district, 2000 ft.; in fl. Feb.; and near Chirinda, 3700 ft.; in young fr. March; n. 215.
Distrib. Tropical Africa.
Chindao name, "Idiya." Common throughout the Jihu district, chiefly in grass jungle. It makes a very rapid growth after the annual jungle fires and grows straight upward till top-heavy, then falls and climbs over any vegetation on which it happens to rest.

D. BECCARIANA, *Martelli, Fl. Bogos*, 83.
Near Chirinda, 3800 ft.; in fl. Dec.; nn. 1091 *a*, 6630.
Distrib. Tropical Africa.

LILIACEÆ.

SMILAX KRAUSSIANA, *Meisn. in Flora*, xxviii. (1845) 312.
Beira, in fl. Dec.; n. 1093: near Chirinda, 3500–5900 ft.; in fl. & fr. Nov., Dec.; n. 212: Chimanimani Mts., 7000 ft.; n. 1099.

Singuni name, "Ingwena Ngulube." A common thorny trailer found throughout the Jihu, Mafusi and Southern Melsetter districts wherever the soil is rich and the grass growth rank.

Distrib. Tropical Africa, Natal.

ASPARAGUS VIRGATUS, *Baker in Saund. Ref. Bot.* t. 214.

Near Chipete forest patch, 3800 ft.; in fl. Oct.; n. 239.

Distrib. Nyasaland, South Africa.

A. PLUMOSUS, *Baker in Journ. Linn. Soc., Bot.* xiv. (1877) 613.

Chirinda, 3700–4000 ft.; n. 240. A climber common in the forest.

Distrib. East tropical Africa; South Africa.

A. ASIATICUS, *Linn. Sp. Pl.* 313.

Beira, 50 ft.; in fr. Dec.; n. 1094: River Chipetzana, 3000 ft., and Upper Buzi; in fl. Oct.; n. 239 *a*.

Distrib. East tropical Africa; South Africa; Tropical Asia.

A. ANGOLENSIS, *Baker in Trans. Linn. Soc.* ser. 2, *Bot.* i. (1876) 254.

Near Chirinda, 3800 ft.; in fl. May, Oct.; n. 520.

Distrib. Angola.

A. AFRICANUS, *Lam. Encyc.* i. 295.

Umtefu River, Lower Buzi, 600 ft.; in fr. Jan.; n. 1096.

Distrib. Tropical and South Africa.

A. ÆTHIOPICUS, *Linn. Mant.* 63.

Chimanimani Mts., 7000 ft.; in fl. Sept.; n. 1092. Growing amongst the rocks.

Distrib. East tropical and South Africa.

A. FALCATUS, *Linn. Sp. Pl.* 313.

Chipete Forest, 3800 ft.; in fl. April; n. 91.

Distrib. Tropical and South Africa; Tropical Asia.

A. MEDEOLOIDES, *Thunb. Prodr.* 66.

Chipete Forest, 3800 ft.; in fl. & fr. April, May; n. 89: Mt. Pene, 7000 ft.; n. 6058.

Distrib. British East Africa; South Africa.

BEHNIA RETICULATA, *Didr. in Vid. Medd. Kjöbenh.* 1854, 183.

Chimanimani Mts., 7000 ft.; in fl. Sept.; n. 1098: Mt. Pene, 7000 ft.; n. 6057: Chirinda Forest, 4000 ft.; in fl. & fr. Oct.; n. 90: Maruma forest patch, 3700 ft.; in fl. Sept.; n. 791.

Distrib. South Africa; not previously recorded from Tropical Africa. Very common in the Chimanimani forest patches, and in Chirinda and Chipete.

DRACÆNA FRAGRANS, *Gawl. in Bot. Mag.* t. 1081.

Mt. Maruma, 3500 ft.; in fl. Sept.; n. 725. A small single-stemmed tree, 30 ft. or so in height; stems to a foot or more in diameter. Flowers pale greenish. Leaves eaten by the rock-rabbits (*Hyrax*). Chirinda Forest, 3700–4000 ft., n. 724 (leaves only) and in fl. Dec., n. 6520: a shrub about 10 feet in height, forming dense handsome clumps here and there throughout the forest and a favourite nesting-place for forest birds.

Distrib. Tropical Africa.

DRACÆNA GAZENSIS, *Rendle*, sp. nov.

Arbor 30–35-pedalis, foliis alternis sessilibus elongatis lineari-lanceolatis acutis, siccis tenuibus; paniculæ speciosæ subpyramidalis ramis primariis patentibus leviter sursum curvatis flores albidos breviter pedicellatos dense fasciculatos supra medium et apice gerentibus; bracteis brevibus deltoideis margine scariosis acuminatis, quam pedicelli brevioribus; perianthii tubo elongato cylindrico lacinias late-lineares paullo excedente: staminibus quam corolla et stylus paullo brevioribus; antheris oblongis sub medio affixis; ovario oblongo.

Hab. Near Chirinda, 3800 ft., in fl. Oct.; Mt. Maruma, 3500 ft., in fl. Sept.; n. 80. A tall slender shrub or small tree with whitish flowers found in the kloofs and common in wooded glens.

Folia 10–24 cm. long., 1·3–2 cm. lat. Panicula 30 cm. long., 20 cm. diametro; rami ad 10 cm. long. Pedicelli 2–4 mm. long. Perianthium 4–4·5 cm. long., laciniæ circ. 2 cm. long., 3 mm. lat.

Evidently near the Usambara species *D. deremensis*, Engler (known only from the description), which it apparently resembles in habit and character of inflorescence, but having smaller narrower leaves and much larger flowers—the perianth in *D. deremensis* is described as 1·5–1·7 cm. long.

"A small tree 30–35 ft. high but slender and nearly always bending over. The largest seen measured 14 inches in diameter at 4 feet from the ground; trunk much furrowed and scored; bark externally greenish-grey but much overgrown with a short moss and some lichen. Common in the Maruma forest patch and in the wooded glens about Chirinda. It occurs too in the Inyamkuwha forest patch."

KNIPHOFIA RHODESIANA, *Rendle*, sp. nov.

Herba elata foliis . . . . ; pedunculo crasso superne bracteis vacuis paucis scariosis munito, bractea infima e basi acuminata lineari-filiformi, cæteris late deltoideis acutis; racemo denso late oblongo; bracteis florentibus late triangulari-ovatis obtusis conspicue uninerviis scariosis albidis; pedicellis brevissimis; perigonio luteo-scarlatino cylindrico-clavato supra ovarium angustato, lobis obtuse triangulari-ovatis; antheris inclusis late ellipticis; stylo exserto.

Hab. Nyabodi River at about 5000 ft.; in fl. April; n. 723.

Pedunculus 5·5 dm. altitudine excedens, 8 mm. crass. Racemus 7 cm. long., 2·5 cm. lat. Bracteæ fertiles circiter 6 mm. long., 2 mm. + lat. Pedicelli vix 2 mm. long. Perigonium circiter 3·5 cm. long.; fauce 5 mm. diam.; lobi 2·5 mm. long. Antheræ 1·5 mm. long.

A member of the section *Uvarieæ* and nearly allied to the South African species *K. uvaria*, Hook., but differing in the colour of the flowers, non-exserted stamens and other details.

ALOE RHODESIANA, *Rendle*, sp. nov.

Acaulescens; foliis rosulatis, e basi late ovata persistente linearibus, margine frequenter minute denticulatis; scapo simplici per totum fere longitudinem bracteato; bracteis scariosis conspicue nervosis sterilibus ovato-acuminatis, florentibus angustioribus quam pedicelli brevioribus; perianthio basi valde stipitato cylindraceo pallide rubro, segmentis ad basin liberis, 5-nerviis, superne 3-nerviis, obtusis; antheris oblongis inclusis; ovarium cylindrico-conicum in stylum breviter attenuatum.

Hab. Melsetter, 6000 ft., n. 6047; Mt. Pene, 7000 ft., n. 6048; in fl. & fr. Oct. A herb with light coral-pink flowers and stems, met with constantly throughout the higher slopes from Umvumvumvu River to Mount Pene.

Folia emarcida vel juvenilia solum exstant. Caulis florens 2·5–3 dm. altus, ad 0·5 cm. crassus; bracteæ steriles 1·5–1·8 cm. long.; racemus 10–15 cm. long. Pedicelli 2·5 cm. long. Perianthium 3·5 cm. long.; segmenta exteriora 5 mm. lat. Antheræ 4 mm. long. Ovarium 8 mm. long. Capsula 2 cm. long.

A member of the section *Leptoaloë* (Berger in Engler's Planzenreich) nearly allied to *A. brunneopunctata*, Engl. & Gilg, from the Kunene district, but a shorter more robust plant, distinguished also by the denticulate leaf-margin.

ALOE SWYNNERTONII, *Rendle*, sp. nov.

Acaulescens; foliis rosulatis late ensiformibus haud maculatis ad margines conspicue dentatis linea cartilaginea cinctis, dentibus subvalidis e basi sinuata deltoideis patulis cum apice corneo brunneo; inflorescentia ramosa 4-pedali, ramis curvato-ascendentibus ultimis corymbosis, racemis abbreviato-capitatis dense multifloris, bracteis ovatis superne tenuiter acuminatis, quam pedunculi duplo brevioribus; floribus salmoneis, perianthio basi rotundato et inflato deinde constricto subcylindraceo decurvato, tubo segmentis duplo breviore, filamentis inclusis.

Hab. Hills near Chipetzana River, 3500 ft.; in fl. April. In short grass; stems 4 feet high rising from a crown of leaves on the ground. Flowers deep salmon.

Folium 3 dm. long., 8 cm. lat. Dentes marginales 0·5 cm. long., circa 1 cm. inter se distantes. Caulis florens 1·25 m. altus ; racemi circiter 4 cm. longi. Pedicelli circiter 1·5 cm. long. Perianthium 2·2 cm. long. ; tubus 7 mm. long.

A distinct species of Berger's section *Tropicales*, though the perianth is rounded at the base. It is characterized by its broadly ensiform regularly prominently toothed leaves, dense shortened raceme, and the short tube of the salmon-coloured perianth.

ANTHERICUM ELONGATUM, *Willd. Sp. Pl.* ii. 136.

Chipetzana River, 3000 ft. ; in fl. April ; n. 773. Zona River, Jihu district, 2000 ft. ; in fl. Nov. ; n. 1751.

Distrib. Angola, British Central Africa, Portuguese East Africa, South Africa.

ANTHERICUM (§ Phalangium) RHODESIANUM, *Rendle*, sp. nov.

Herba parva, rigidula, glabra, foliis pluribus radicalibus e basi vaginante anguste lineari-acuminatis plus minus revolutis striatis, scapum subteretem striatum nudum subæquantibus vel excedentibus ; floribus ad apicem scapi congestis ; bracteis atrorubris e basi ovato acuminatis superioribus spathiformibus scariosis, pedicellos sub apice articulatos excedentibus ; alabastris apice quasi ustulatis ; perianthio 1 cm. long., segmentis ellipticis albis medio dorso 5-nerviis et atro-rubris apice nigrescentibus ; filamentis glabris quam antheræ oblongæ brevioribus.

Hab. Melsetter, 6000 ft. ; in fl. Oct. ; n. 6056. A small herb with white flowers growing among short grass.

Folia interiora 9–20 cm. long., 2 mm. lat., exteriora breviora. Scapus ad 16 cm. long. ; inflorescentia dense congesta vix 2·5 cm. long. Bracteæ 1 cm. long. vel breviores. Pedicellus 4 mm. long. Perianthium 1 cm. long., antheræ 3·5–4 mm. long., filamenta vix 3 mm. long.

Near *A. ustulatum*, Baker, from Angola (Huilla and Pungo Andongo), but distinguished by its somewhat larger flowers with a deep crimson keel and almost black tips to the petals, and the absence of the dark-crimson barred sheaths enveloping the leaf-bases.

CHLOROPHYTUM GAZENSE, *Rendle*, sp. nov.

Herba minor glabra fibris radicalibus fasciculatis interdum fusiforme incrassatis, foliis pluribus radicalibus basi vaginatis, lamina sicca papyracea 9–11 nervia anguste lanceolata acuminata apice acutissima, basi in petiolum plus minusve elongatum transeunte ; scapo folia excedente laxifloro, floribus inter minores in axillis bractearum spathiformarum apice tenuiter acuminatarum 2–3-fasciculatis ; pedicello medio articulato ; perianthii segmentis lineari-oblongis obtusis 3-nerviis ; staminibus perianthio paullo brevioribus, filamentis glabris supra ovarium dilatatis sub anthera lineari flava acuminatis;

stylo gracili filamenta æquante; ovario depresso-globoso, ovulis in loculo 3; capsula valde emarginata angulata.

Hab. Chirinda Forest, 3700–4000 ft.; in fl. & fr. Apr., May; nn. 318, 527. A small plant with white petals and yellow anthers, common in the forest.

Folia sæpe 12–15 cm. long., interdum ad 23 cm., lamina petiolum cum vagina subæquante, sæpius 1·4–1·5 cm. lat. Scapus 20–40 cm. long. Bractea sterilis in parte scapi inferiore lineari-acuminata 1·5–3 cm. long.; bracteæ florentes 2–0·5 cm. long. Perianthii segmenta 1 mm. lat., exteriora 5 mm., interiora vix 6 mm. long.; antheræ 1·5 mm. long.; ovarium 1·25 mm. long. Capsulæ valvis 0·5 cm. long.

The form of the leaf recalls the West African *C. alismæfolium*, Baker, but the petiole is not sharply separated from the blade, and the species is probably nearer *C. laxum*, R. Br., though at once distinguished by its broader lanceolate leaves.

CHLOROPHYTUM ANGUSTIFOLIUM, *Rendle*, sp. nov.

Herba rhizomate tenui ut apparet reptans, collo nodisque rhizomatis parce setosis; foliis paucis tenuibus basalibus glabris e vagina brevi valde elongatis, petiolo elongato in laminam anguste linearem lanceolatam longe acuminatam multinerviam nervo mediano conspicuo transeunte; scapo nudo tenui foliis breviore superne sparse puberulo; racemo puberulo haud bene evoluto multifloro, floribus geminis; bracteis e basi ovata longe acuminatis margine minute serratulis; pedicellis brevibus medio articulatis; perianthii albidi segmentis trinerviis, exterioribus anguste lineari-lanceolatis, interioribus anguste ovali-oblongis; antheris flavis lineari-oblongis, filamentis glabris; ovario ellipsoideo, ovulis in loculo multis, stylo gracili.

Hab. Madanda forests at about 400 ft.; in fl. Dec.; n. 772. A herb with white flowers.

Folia (petiolo incluso) ad 5 dm. long. et 9 mm. lat., petiolum $\frac{1}{2}$–$\frac{2}{5}$ totius longitudinis; scapus (racemo excluso) 28 cm. long., racemus nondum perfecte evolutus 8 cm. long. Pedicelli circiter 3 mm. long. Perianthium 1 cm. long.; segmenta exteriora 1·4 mm. lat., interiora 2·6 mm. lat.; stamina 7·5 mm. long., antheris 4·5 mm. long. inclusis; ovarium 2 mm. long.; stylus 11 mm. long.

Recalls the widely distributed *C. laxum*, R. Br., in habit, but has larger flowers and the long narrow grass-like leaves are more lanceolate in form.

C. BLEPHAROPHYLLUM, *Schweinf. ex Baker in Journ. Linn. Soc., Bot.* xv. (1876) 327.

Near Chirinda, 3500 ft.; in fl. Oct.; n. 329: Lower Zona, Jihu district, 2000 ft.; n. 330.

Distrib. Tropical Africa.

Dipcadi viride, *Mœnch, Meth. Suppl.* 267.
Near Chirinda 3500–3800 ft.; in fl. Oct.; n. 59.
Distrib. East tropical Africa; South Africa.

Urginea altissima, *Baker in Journ. Linn. Soc., Bot.* xiii. (1872) 221.
Near Chirinda, 3800 ft.; in fl. & fr. Apr.; n. 321 *a*.
Distrib. Tropical and South Africa.

Scilla rigidifolia, *Kunth, Enum.* iv. 330.
Northern Melsetter, 5000–6000 ft.; in fl. Oct.; nn. 6053, 6226: Mt. Pene, 7000 ft.; in fl. & fr. Oct.; n. 6054.
Distrib. Angola, German East Africa; South Africa. A small herb with white flowers, fairly common amongst the short grass of the mountains.

S. indica, *Baker in Saund. Ref. Bot.* iii. App. 12.
Mt. Pene, 6500–7000 ft.; in fl. Sept., Oct.; nn. 767, 6055.
Distrib. East tropical Africa; also India and Ceylon. A small herb of the open grass veld. Flowers green and purplish. The leaves are broader and less tapering below than in typical specimens of this species; and the Mt. Pene plants may perhaps represent a distinct species.

Gloriosa superba, *Linn. Sp. Pl.* 305.
Chipetzana River, 3000 ft.; in fl. Apr.: Kurumadzi River, Jihu district, 2000 ft.; in fl. Jan.; n. 716: Chirinda outskirts, 3800 ft.; in fl. Dec.; nn. 6507, 6509.
Distrib. Tropical Africa, Transvaal; also Tropical Asia.

COMMELINACEÆ.

Commelina Livingstonii, *C. B. Clarke in DC. Mon. Phan.* iii. 190.
Kurumadzi River, 2000 ft.; in fl. Nov.; n. 762. A common herb, wild in cultivated ground; flowers cobalt-blue.
Distrib. East tropical and South Africa.

Aneilema sinicum, *Lindl. in Bot. Reg.* t. 659.
Chirinda Forest, 3700–4000 ft.; in fl. May; n. 765: Kurumadzi River, 2000 ft.; in fl. & fr. Nov.; n. 763: Madanda forests, 400 ft.; in fl. & fr. Dec.; n. 756.
Distrib. A common Tropical African weed; also South Africa and Asia.

Floscopa glomerata, *Hassk. Commel. Ind.* 166.
Chirinda, 3700 ft.; in fl. & fr. June; n. 764: Upper Buzi, 3000 ft.; in fl. & fr. Apr.; n. 761. In swampy ground; flowers dull purple.
Distrib. South tropical Africa; South Africa; Mascarene Islands.

PALMACEÆ.

PHŒNIX DACTYLIFERA, *Linn. Sp. Pl.* 1188.

Near Chirinda, 3500 ft. ; in fl. & fr. Oct. ; n. 666.

Distrib. The date-palm, widely cultivated in Tropical Africa.

Fairly common in the neighbourhood of Chirinda along streams and to a less extent in the open bush. Occurs also in other parts of the Melsetter district (including especially the Chipetzana River, the Myanyadzi and the Umvumvumvu), up to nearly 6000 ft. It appears not to occur much below 3000 ft. Also noted in some numbers in the Umtali district, notably on the Umtali River.

HYPHÆNE VENTRICOSA, *Kirk in Journ. Linn. Soc., Bot.* ix. (1866) 235.

Umhlonhlo, Lower Buzi, 100 ft. ; fruit only. A large fan-leaved palm.

Distrib. Congo, Damaraland, Zambesi River.

"A tall palm becoming increasingly common as one approaches the coast from the highlands. On the north side of the River Buzi there are a number in the neighbourhood of the Amanzimhlope, a stream to the east of the Sitatonga forest. On the south the first, mere stunted specimens, were noted at Zinyumbo. They become common, still in a small form, from the east bank of the Mwangezi onwards, the first really large specimens with a large bulge in the stem (apparently only acquired when old) being at Chimbuya. Between Muchukwana and Chironda, and again between Boka and Umhlonhlo, there are a considerable number, especially about Inyamita, and there are much larger specimens at Inyajena."

TYPHACEÆ.

TYPHA AUSTRALIS, *Schumach. & Thonn. Beskr. Guin. Pl.* 401.

Beside the Zinyumbo pools, Zinyumbo Hills, 1500 ft. ; Nov. ; n. 961.

Distrib. North Tropical and South Africa.

AROIDEÆ.

AMORPHOPHALLUS (§ Hydrosme) SWYNNERTONII, *Rendle*, sp. nov.

Herba foliis ignotis, inflorescentia glabra, pedunculo et tubo spathæ sparse verruculoso, spatha in parte inferiore convoluta, tubo late cylindrico basi paullo inflato, intus verrucoso, limbo late ovato acuminato patente undulato, spadice sessili spathæ subæquali, parte florifera feminea cylindrica, mascula superne paullo attenuata, floribus dense aggregatis contiguis, appendice gradatim attenuata apice obtusa in parte inferiore sparsius verruculosa : ovario subgloboso uniloculari, stigmate sessile suborbiculari ; antheris densissime aggregatis.

Hab. Madanda forests at about 400 ft. ; in fl. Dec. ; n. 717 *a*.

Pedunculus 28 cm. long., 0·5 cm. crass. ; spathæ tubus 7 cm. long., parte

feminea 2·5 cm. crass.; limbus 20 cm. long., 12 cm. lat. Spadix 28 cm. long., pars feminea 1·5 cm. long., 2 cm. crass., pars mascula 5 cm. long. apice 1·5 cm. crass.; appendix inferne 1 cm. apice 4 mm. crass. Ovarium 4 mm. long.

A very distinct species, perhaps nearest to *A. Fischeri*, N. E. Br., from South-East tropical Africa, but distinguished by the relatively shorter spadix, which is twice as long as the spathe in *A. Fischeri*, the one-celled ovary, &c. There is in the Kew Herbarium a very similar specimen, but with a much stouter spadix, collected by W. W. Johnson at Sofala at the sea-level.

Culcasia scandens, *Beauv. Fl. Owar.* 1. 4, t. 3.
Chirinda Forest, 3700–4000 ft.; in fl. & fr. Jan.; n. 98.
Distrib. Tropical Africa.

Stylochiton gazense, *Rendle*, sp. nov.

Herba glabra, vix pedalis, rhizomate crasso fibris vaginarum persistentibus induto et parte superiore radices crassas simplices emittente; foliis (4) eodem tempore cum floribus evolutis, petiolo in parte inferiore dilatato vaginæformi laminam excedente; lamina hastata lobo mediano late oblongo apice apiculato, lobis basalibus ovato-triangularibus; pedunculo e medio foliorum vaginarum orto petiolis valde breviore; spatha foliis breviore, tubo sub medio inflato superne cylindrico, limbo oblongo-lanceolato apice acuminato; spadice vix protruso; floribus femineis numerosis aggregatis; perianthio cupuliformi margine crasso, ovario libero ovoideo-angulato biloculato, ovulis in quoque loculo singulis ex apice partitionis centralis pendulis, stylo crasso ex ore perianthii exserto; parte spadicis mascula parti femineæ contigua dense multiflora; perianthio quam in flore femineo breviore nec superne contracto margine undulato; staminibus in quoque flore 4 exsertis, filamentis tenuibus quam antheræ longioribus, antheris subglobosis cellulis parallelis, ovarii rudimento centrali parvo.

Hab. Madanda forests, 400 ft.; in fl. Dec.; n. 717. A herb with green spathes, common on ant-heaps in *Brachystegia* bush.

Rhizoma 0·5 cm. crass.; folia ad 3 dm. long.; petiolus cum vagina ad 1·9 dm. long., lamina 11 cm. long.; lobus medianus 6 cm. lat., lobi basales vix 8 cm. long. Pedunculus 8 cm. long. Spatha cum apiculo 10 cm. long., tubus 5 cm. long., sub medio 1·75 cm. diam., limbus 1·6 cm. lat. Spadicis pars feminea 1·6 cm. long, pars mascula 4 cm. long. Perianthium floris feminei 3 mm. long., stylus 2 mm.; perianthium floris masculi 1 mm. long., filamenta 2·5 mm. long., antheræ 1·5 mm. long.

Near the South African *S. maximus*, in which however the leaf and spathe are much larger and the leaf has a cordate base.

POTAMOGETONACEÆ.

POTAMOGETON PUSILLUS, *Linn. Sp. Pl.* 127.

Inyamadzi River, 2500 ft.; Sept.; n. 958.

Distrib. East and West tropical Africa; widely distributed in warm and temperate regions.

CYPERACEÆ.

The collection includes the following well-known Tropical African species:—*Pycreus polystachyos*, Beauv. (Beira, Lower Buzi and Sabi River, 1000 ft.), and its var. *laxiflora* (near Chirinda, 3500 ft.); *Cyperus amabilis*, Vahl (Beira); *C. Haspan*, Linn. (Chirinda, 3500 ft.); *C. distans*, Linn. f. (Chirinda, 3700 ft.); *C. Zollingeri*, Steud. (Beira); *C. rotundus*, Linn. (Lower Buzi); *C. Fenzelianus*, Steud. (Lower Buzi); *Mariscus Sieberianus*, Nees (Chirinda, 3800 ft.); *Fimbristylis diphylla*, Vahl (Chirinda, 3700 ft.); *F. exilis*, Rœm. & Schultes (Chirinda, 3000–6000 ft., Chimanimani Mts., 7000 ft., Upper and Lower Buzi); *Fuirena pubescens*, Kunth (Chirinda, 3500 ft.); *F. glomerata*, Lam. (Beira); *Lipocarpha argentea*, R. Br. (Chirinda, 3500 ft., Lower Jihu, 2000 ft.); and *Rhynchospora aurea*, Vahl (Mt. Maruma, 3500 ft.).

KYLLINGA ALBA, *Nees in Linnæa*, x. (1836) 140.

Beside a water-furrow in cultivated ground near Chirinda, 3800 ft.; in fl. May; n. 459.

Distrib. East and South tropical Africa; South Africa.

PYCREUS REHMANNIANUS, *C. B. Clarke in Durand & Schinz, Consp. Fl. Afr.* v. 542.

Kurumadzi, River Jihu, 2000 ft.; Nov.; n. 928. At water's edge.

Distrib. Transvaal; Natal.

CYPERUS COMPACTUS, *Lam. Ill.* i. 144.

Northern Melsetter, 2000–6000 ft.; in fl. Apr.; n. 916 *b*: Mt. Pene, 6800 ft.; in fl. Sept.; n. 916: Indunda River, Lower Buzi, 100 ft.; in fl. Dec.; n. 916 *a*.

Distrib. Tropical and South Africa and the Mascarene Islands.

C. MARITIMUS, *Poir. in Lam. Encycl.* vii. 240.

Beira beach; in fl. Dec.; n. 936.

Distrib. West and South-East tropical Africa; Madagascar.

C. SPHÆROSPERMUS, *Schrader, Anal. Fl. Cap.* 8.

Lower Umswirizwi River, 1000 ft.; in fl. Dec.; n. 935: Beira, open woods, 50 ft.; in fl. Dec.; n. 935 *a*.

Distrib. Somaliland, Angola; also in South Africa and Madagascar.

CYPERUS FLABELLIFORMIS, *Rottb. Descr. et Ic.* 42.

Inyamadzi Valley, 2500 ft.; in fl. Sept.; n. 934: Kurumadzi River, Jihu, 2000 ft.; n. 929: Idunda River, Lower Buzi, 100 ft.; Dec.; n. 930.

Distrib. East tropical Africa, Congo, Angola; also South Africa and Mascarene Islands.

C. PROLIFER, *Lam. Ill.* i. 147.

Beira, open woods, 50 ft.; in fl. Dec.; n. 931. Common along the railway line.

Distrib. East tropical Africa; Mascarene Islands.

C. ALBOSTRIATUS, *Schrad. Anal. Fl. Cap.* 7.

Mt. Pene, 7000 ft.; in fl. Oct.; n. 6036. Common in an open patch, in a wooded gorge, beside a stream.

Distrib. South Africa to Natal and Transvaal.

MARISCUS DREGEANUS, *Kunth, Enum.* ii. 120.

Beira: Boka, Lower Buzi, 100 ft.: Madanda forests, 400 ft.: in fl. Dec.; n. 917.

Distrib. West tropical Africa, Mozambique district; South Africa, Mascarene Islands, Tropical Asia.

M. HEMISPHÆRICUS, *C. B. Clarke in Durand & Schinz, Consp. Fl. Afr.* v. 589.

Madanda forests, 400 ft.; Dec.; n. 946: near Chirinda, 3800 ft.; April; n. 412.

Distrib. East tropical Africa.

SCIRPUS CORYMBOSUS, *Roth, Nov. Pl. Sp.* 28.

Melsetter, 6000 ft.; Sept.; n. 906: Inyamadzi Valley, 3000 ft.; Oct.; n. 905.

Distrib. East tropical Africa, Angola; Egypt, South Africa, Madagascar, India.

FIMBRISTYLIS RHODESIANA, *Rendle*, sp. n.

Herba annua, parva, cæspitosa, pilosula, habitu formæ parvæ *F. exilis*, culmis gracilibus striatis patule pilosulis; foliis culmis dimidio brevioribus tenuibus flaccidis interdum spiraliter tortis pilosulis; umbellæ spiculis 3–5, pedicellatis; bracteis umbella brevioribus; spiculis ovatis compressis multifloris (plus quam 20), castaneo-brunneis; glumis caducis ovatis obtusis inconspicue pilosulis, carina pallida haud mucronata; floribus usque ad apicem spiculæ bisexualibus; staminibus 3, antheris filamentis multo brevioribus; stylo nucem excedente, ramis 3 exceptis glabro, basi dilatato pyramidato supra nucem constricto; nuce albescente parva trigona obovoidea transverse rugulosa.

Hab. Upper Buzi, 3000–3500 ft.; April; n. 920.

Planta 1 dm. alta. Folia linearia vix 0·5 mm. lat., facie superiore plana glabra, facie inferiore convexa pilosula et cum venis 3 longitudinaliter striata. Culmi 0·3 mm. diam. Umbellæ rami 6–9 mm. long. Spicæ 0·5 cm. long.; glumæ 3 mm. long.; antheræ 0·3 mm. long.; stylus cum ramis 2 mm. long.; nux vix 1 mm. long.

A characteristic little plant belonging to the section *Trichelostylis*, with the habit of small slender forms of *F. exilis*, Rœm. & Schult., from which, however, it is distinguished by the relatively broader and shorter many-flowered spikelets, the readily falling glumes, shorter anthers, and smaller nut.

Fuirena stricta, *Steud. Syn. Pl. Glum.* ii. 128.

Near Chirinda, 3700 ft.; in fl. Jan.; n. 910. Beside water.

Distrib. Upper Guinea, British East Africa, Nyasaland; Madagascar.

Rhynchospora candida, *Bœck. in Linnæa,* xxxvii. (1871–73) 605.

Beira, open woods, 50 ft.; in fl. Dec.; n. 915.

Distrib. West tropical and South-East tropical Africa; Madagascar; Tropical South America.

Scleria melanomphala, *Kunth, Enum.* ii. 345.

Hargwe head-waters, Jihu, 2500 ft.; in fr. Jan.; n. 420.

Distrib. Tropical and South Africa; Madagascar.

S. racemosa, *Poir. in Lam. Encycl.* vii. 6.

Jihu, Kurumadzi River, 2000 ft.; in fl. Nov.; n. 902. Near the river.

Distrib. Tropical Africa, Mascarene Is.

Eriospora villosula, *C. B. Clarke in Trans. Linn. Soc.* ser. 2, *Bot.* iv. (1894) 54.

Chimanimani Mts., 7000 ft.; in fl. Sept.; n. 918. Common on the cliff-ledges.

Distrib. German East Africa, Nyasaland.

Carex spicato-paniculata, *C. B. Clarke in Durand & Schinz, Consp. Fl. Afr.* v. 690.

Near Chirinda, 3000 ft.; June; n. 413.

Distrib. German East Africa; South Africa and Mascarene Islands.

C. condensata, *Nees, in Wight, Contrib.* 123.

Mt. Pene Forest, 6500–7000 ft.; in fl. Sept.; n. 903. Common in the forest.

Distrib. Nyasaland; also India.

GRAMINEÆ.

The collection includes the following well-known African species:—*Imperata arundinacea* var. *Thunbergii*, Hack. (Northern Melsetter, 4000–5000 ft., and Beira); *Rottbœllia compressa* var. *fasciculata*, Hack.; *Heteropogon hirtus*, Pers. (Northern Melsetter, 4000–6000 ft.; Upper Buzi, 3000–3500 ft.); *Sorghum vulgare*, Pers., and *S. halepense*, Pers. (Lower Buzi); *Themeda triandra*, Forsk. (Northern Melsetter, 4000–6000 ft., near Chirinda 3500 ft., Lusitu River, 3000 ft., Nyahodi River, 4000 ft.); *Paspalum scrobiculatum*, Linn. (Northern Melsetter, 4000–6000 ft., near Chirinda, 3700 ft., Lower Buzi); *Panicum colonum*, Linn., and *P. Crus-galli*, Linn. (Lower Buzi); *P. maximum*, Jacq. (Chirinda, 3700–4000 ft., Lower Buzi); *P. uncinatum*, Raddi (Chipete forest patch, 3800 ft., Chirinda Forest, 3700–4000 ft.); *Tricholæna rosea*, Nees (Northern Melsetter, 4000–6000 ft., Nyahodi River, 4000 ft., near Chirinda, 3500–3800 ft., Upper Buzi, 3000–3500 ft., Beira, 50 ft.); *Oplismenus africanus*, Beauv. (Chipete forest patch, 3800 ft.); *Setaria aurea*, A. Br. (Northern Melsetter, 4000–6000 ft., Chirinda, 3000 ft., Upper and Lower Buzi); *S. verticillata*, Beauv. (near Chirinda, 3500 ft., Chipete forest patch, 3800 ft.); *Olyra latifolia*, Linn. (Chipete forest patch, 3800 ft.); *Perotis latifolia*, Ait. (near Chirinda, 3700 ft., and Lower Buzi); *Tragus racemosus*, Scop. (Madanda forests, 400 ft., and Lower Buzi); *Kœleria cristata*, Pers. (Mt. Pene, 6500–7000 ft.); *Phragmites communis*, Trin. (Nyahodi River, 4000 ft., Lusitu River, 2500 ft.); *Aristida Adscensionis*, Linn. (Northern Melsetter, 4000 ft.); *Sporobolus virginicus*, Kunth (Beira beach); *Cynodon Dactylon*, Pers. (near Chirinda, 3800 ft., Lower Buzi, 400 ft.); *Chloris barbata*, Sw. (near Chirinda, 3500 ft., Northern Melsetter, 4000 ft.); *Eleusine indica*, Gærtn. (Northern Melsetter, 6000 ft., near Chirinda, 3500 ft.); *E. verticillata*, Roxb. (Lower Buzi, 100–400 ft.); *Dactyloctenium ægyptiacum*, Willd. (Northern Melsetter, 4000–6000 ft.); *Leptochloa filiformis*, Beauv. (Lower Buzi, 0–400 ft.); *Eragrostis chalcantha*, Trin. (Northern Melsetter, 3000–6000 ft.); *E. major*, Host (Northern Melsetter, 4000–6000 ft., Upper Buzi, 3000–3500 ft.); *E. superba*, Peyr. (Lower Buzi); *E. aspera*, Nees (Chirinda, 3700–4000 ft.).

ANATHERUM MURICATUM, *Beauv. Agrost.* 150, t. 22.
Chibabava, Lower Buzi, 400 ft.; Dec.; n. 956. A grass with a very blue appearance, common on edges of pools.
Distrib. West and Central tropical Africa.

ISCHÆMUM FASCICULATUM, *Brongn.*, var. ARCUATUM, *Hack. Androp.* 235.
Lusitu River, 3000 ft.; Apr.; n. 1652.
Distrib. Eastern South Africa (Kei River to Natal).

ISCHÆMUM GLAUCOSTACHYUM, *Stapf in Dyer, Fl. Cap.* vii. 328.
Umhlonhlo, Lower Buzi, 100 ft. ; Jan. ; n. 1573.
Distrib. Transvaal.

ELIONURUS ARGENTEUS, *Nees, Fl. Afr. Austr.* 95.
Near Chirinda, 3700 ft. ; Jan. ; n. 1624 ; a common grass : Mt. Pene, 6500–7000 ft. ; Sept. ; n. 1648 ; a small grass.
Distrib. Tropical and South Africa.

ANDROPOGON HIRTIFLORUS, *Kunth*, var. SEMIBERBIS, *Stapf in Dyer, Fl. Cap.* vii. 337.
Northern Melsetter, 4000–6000 ft. ; April ; n. 1607 : near Chirinda, 3500 ft. ; Jan. ; n. 1621.
Distrib. Tropical and South Africa ; widely distributed in the tropics.

A. CERESIÆFORMIS, *Nees, Fl. Afr. Austr.* 109.
Beira, open woods, 50 ft. ; Dec. ; n. 1598 : hills between Lusitu and Nyahodi, 5000 ft. ; April ; n. 1656.
Distrib. Tropical South Africa.

A. GAYANUS, *Kunth, Rev. Gram.* i. 163.
Zinyumbo Hills, 1500 ft.; Jan. ; n. 1555 : near Chirinda, 3800 ft.; April ; n. 937 : Upper Buzi, 3000–3500 ft. ; April ; n. 984.
Distrib. Tropical Africa.

A. PERTUSUS, *Willd. Sp. Plant.* iv. 922.
Northern Melsetter, 4000–6000 ft. ; April ; n. 1613.
Distrib. Tropical and South Africa ; Tropical Asia to North Australia.

A. SCHIRENSIS, *Hochst. ex Rich. Tent. Fl. Abyss.* ii. 456.
Near Chirinda, 3500 ft. ; Dec. ; n. 1624 ; a common grass.
Distrib. Tropical Africa.

CYMBOPOGON SCHŒNANTHUS, *Spreng.*, var. VERSICOLOR, *Hack. Andropog.* 610.
Northern Melsetter, 4000–6000 ft. ; April ; n. 1689 : Nyahodi River, at about 4000 ft. ; April ; n. 1676 : near Chirinda, 3500 ft. ; Jan. ; n. 1641 : Zinyumbo Hills, 1500 ft. ; Jan. ; n. 1556 : Lower Buzi, 100 ft. ; Dec. ; nn. 970, 1560, 1570, 1576.
Distrib. East tropical and South Africa ; Mascarene Islands, India.

Var. DENSIFLORUS, *Hack. l. c.* 611. Melsetter, 6000 ft. ; April ; n. 2098.
Distrib. Tropical Africa.

CYMBOPOGON GIGANTEUS, *Chiov. Intorn. alc. Gram. Essenza*, 12.

Near Chirinda, 3500 ft.; Jan.; n. 1636: Upper Buzi, 3000–3500 ft.; April; n. 994.

Distrib. Tropical Africa.

C. RUFUS, *Rendle, in Cat. Welw. Afr. Pl.* ii. 155.

Melsetter, 4000–6000 ft.; April; nn. 1606, 1712: Lusitu River at about 3500 ft.; April; n. 1655: Upper Buzi, 3000–3500 ft.; April; n. 993.

Distrib. Tropical and South Africa and Mascarene Is.; Brazil.

Var. FULVICOMUS, *Rendle, l. c.* Upper Buzi, 3000–5000 ft.; April; n. 995.

Distrib. Tropical Africa.

CYMBOPOGON GAZENSE, *Rendle,* sp. nov.

Gramen perenne (?) metrale, internodiis culmi validis teretibus glabris, nodis inferioribus geniculatis (basalibus radicantibus), superioribus erectis; vaginis præter marginem tuberculoso-hirsutum glabris, inferioribus internodia subæquantibus, superioribus internodiis valde brevioribus; ligula brevi truncata glabra; lamina e basi constricta lineari-acuminata subtus sparse pilosa margine (interdum quoque supra) scabrida costa media albo-lineata subtus prominente, nervis lateralibus prominulis; panicula foliosa folia excedente angusta sublaxa; spathis lanceolatis acuminatis membranaceo-scariosis brunneis margine inferiore excepta glabris, dorso superne carinato scabridulo; pedunculis communibus filiformibus inclusis sub apice albido-pilosis; racemis e medio spathæ flabelliformi exsertis contiguis, uno sessili, altero cum pedunculo brevissimo dense albido-hirsuto; articulis 1–2 ciliatis pedicellis similibus; spiculis brunneo-viridibus, eis paris infimi racemi sessilis homogamis (♂); spiculis ceteris sessilibus ☿ oblongis superne angustatis gluma inferiore chartacea truncata pubescente præcipue in sulco mediano, nervis intracarinalibus 3 sub apice solum manifestis, carinulis præcipue in parte superiore scabridulis, callo brevi barbato; gluma superiore membranacea, obtusa, 3-nervia, nervis lateralibus superne ciliolatis; gluma IV. lineari apice bidentata pæne ad aristam geniculatam brunneam gracilem reducta; spiculis pedicellatis ♂ vel neutris, gluma I. lineari-lanceolata cuspidata dorso conspicu 7-nervata nervis scabridulis, carinis ciliatis.

Hab. Near Chirinda, 3700 ft.; Jan.; n. 1637. A tall grass, common.

Internodia 5·5–12 cm. long, medio 2 mm. crass. Vaginæ 5–7 cm. long.; ligula 0·75 mm. long.; lamina ad 25 cm. long., 8 mm. lat. Panicula 18 cm. long. Spathæ propriæ 2·2–2·7 cm. long. Racemi 1·2–1·4 cm. long.; articuli 1·5 mm. long. Spiculæ ☿ 4·5 mm. long.; antheræ 2 mm. long.; arista circiter 2 cm. long.; paullo sub medio geniculata. Spiculæ pedicellatæ 8 mm. long.; antheræ 3 2 mm. long. Spiculæ paris homogamæ 7 et 8 mm. long.

Near *C. Schimperi*, Rendle, but a more graceful plant with smaller, more compact racemes, shorter-awned sessile spikelets and larger stalked spikelets.

CYMBOPOGON SCHIMPERI, *Rendle in Cat. Welw. Afr. Pl.* ii. 155.

Northern Melsetter, 4000–6000 ft.; April; n. 951: Upper Buzi, 3000-3500 ft.; April; n. 994 *a*.

Distrib. East tropical Africa, Angola, Natal.

C. ELEGANS, *Spreng. Pug. Pl. Nov.* ii. 14.

Nyahodi River at about 4000 ft.; April; n. 1675.

Distrib. Tropical East Africa, Angola, Natal, Mascarene Is.

C. TAMBA, *Rendle,* comb. nov.

Andropogon lepidus, var. *Tamba*, Hackel.

Northern Melsetter, 4000–6000 ft.; April; nn. 950, 1690: near Chirinda, 3806 ft.; April; n. 415.

Distrib. Abyssinia.

C. FILIPENDULUS, *Rendle in Cat. Welw. Afr. Pl.* ii. 157.

Northern Melsetter, 4000–6000 ft.; April; n. 1687: near Chirinda, 3500 ft.; Jan.; n. 1640: Upper Buzi, 3000–3500 ft.; April; nn. 985, 988, 990.

Distrib. Tropical Africa, Natal, Ceylon, Australia.

C. LECOMTEI, *Rendle*, comb. nov.

Andropogon Lecomtei, Franch. in Bull. Soc. Hist. Nat. d'Autun, viii. 329 (1895).

Nyahodi River, 4000 ft.; April; n. 1660.

Distrib. Congo, Nyasaland.

C. RUPRECHTII, *Rendle in Cat. Welw. Afr. Pl.* ii. 160.

Northern Melsetter, 4000–5000 ft.; April; nn. 1605, 1686: Nyahodi River at 4000 ft.; April; n. 1659 *a*: Upper Buzi, 3000–3500 ft.; April; n. 991.

Distrib. Tropical Africa, Transvaal, Madagascar; also in Mexico.

ISACHNE ALBENS, *Trin. Ic. Gram.* 8, t. 85.

Chipete forest patch, 3800 ft.; April; n. 406.

Distrib. Tropical Africa; tropical Asia.

DIGITARIA ERIANTHA, *Steud. in Flora*, xii. (1829) 468.

Lower Buzi, 100 ft.; Dec.; n. 1586.

Distrib. South Africa to the Zambesi.

DIGITARIA SWYNNERTONII, *Rendle*, sp. nov. (Pl. **6**. figs. 6–10.)

Gramen perenne, rhizomate squamis pilosis obtecto, culmo erecto subterete 4-nodo basi vaginis marcidis vestito, nodis glabris, vaginis laxis internodia subæquantibus, glabris; ligula brevi truncata fimbriata; lamina lineari-acuminata plana basi subcordata facie interiore et juxta ligulam pilosa, pilis

e basi tumido ortis; panicula folia valde superante, racemis in axi communi racemis breviore fastigiatis verticillatis superne interdum oppositis vel alternatis; rhachilla trigona margine minute denticulata, quam spicula vix latiore; spiculis rhachi appressis geminis, alter subsessilis, alter breviter pedicellata, basi quaternis, deinde ternatis, ovali-oblongis acutis; gluma I. minuta, triangulari-acuta; gluma II. spicula duplo breviore, plus minus scabridula, ovato-triangulari acuta 3-nervia longe-pilosa; gluma III. ovato-acuta 5-nervia, nervis marginalibus obsolete pilosulis, quam gluma IV. paullulo longiore; gluma IV. ovali-oblonga acuta valde convexa viridi-lurida minutissime puncticulata.

Hab. Zinyumbo Hills, 1500 ft.; Jan.; n. 1554.

Rhizoma 3–4 mm. crass. Culmus ad basin inflorescentiæ 11 dm. long., 2·5 mm. crass. Vaginæ 9–28 cm. long.; laminæ ad 25 cm. long. et 6 mm. lat., ligula 1·5 mm. long. Panicula 18–20 cm. long., racemi 11–13, 13–17 cm. long. Spicula 2·5 mm. long., pedicellus 1·5 mm. long.; gluma II. 1 mm. long.; gluma III. 2·5 mm. long.

Near *D. eriantha*, Steud., but a more graceful plant with slenderer racemes and more closely appressed, somewhat smaller, very acute spikelets; the third glume is almost or quite glabrous.

DIGITARIA SANGUINALIS, *Scop.*, var. CILIARIS *Rendle in Cat. Welw. Afr. Pl.* ii. 163.

Beira beach; Dec.; n. 1588.

Distrib. Widely spread in the tropics.

Var. HORIZONTALIS, *Rendle, l. c.* Near Chirinda, 3800 ft.; April; n. 964.

Distrib. Tropical and South Africa; Mascarene Islands and Tropical America.

DIGITARIA GAZENSIS, *Rendle*, sp. nov. (Pl. **6**. figs. 1–5.)

Gramen perenne, bipedale, rhizomate brevi lignoso squamis breviter tomentosis obtecto; culmis erectis gracilibus subcompressis præter nodos glaberrimis specimine 4-nodis, nodis pilosis; foliis glabris, vaginis laxis, laminis planis anguste linearibus acuminatis, nervo mediano dorso prominulo, ligula brevi rotundata; racemis 6–9, in rhachi gracillima alternatim vel subopposite ordinatis patulis vel suberectis laxifloris; spiculis geminis, altera brevius altera longius pedicellata, ovalibus; rhachilla tenui compressse-trigona margine minute denticulata spiculis plus duplo angustiore; gluma I. 0; gluma II. ovali-oblonga 5-nervia, nervis 2 lateralibus mediano proximis crassis margine et nervis albide-pilosis, inter nervos fragili spiculam æquante; gluma III. late ova'i II. simili; gluma IV. elliptica viridi-lurida valde convexa breviter acuta minutissime seriatim puncticulata.

Hab. Beira, open woods; 50 ft.; Dec.; n. 1593.

Culmi c. 6 dm. alt., 2 mm. diam. Vaginæ internodia subæquantes vel

breviores, laminæ 22 cm. long. vel breviores, 3 mm. lat. ; ligula 1·5 mm. long. Panicula 12–15 cm. long., rami 7–11 cm. long. Spicula 2 mm. long. ; pedicellus alter vix 0·5 mm., alter 2 mm. long.

A distinct species characterized by its graceful habit, elongated linear leaves, hairy nodes, slender racemes, and small spikelets in which the first glume is wanting. The inflorescence recalls that of some forms of *Digitaria mutica* (*Panicum scalarum*, Schweinf.), but the racemes are longer and more slender and the spikelets less turgid.

PANICUM HUMIDICOLUM, *Rendle in Welw. Cat.* ii. 169.

Beira, open woods, 50 ft. ; Dec. ; n. 1596 *b*.

Distrib. Angola, Huilla. Differs from the type specimen in the slightly smaller, less hairy spikelets.

P. BRIZANTHUM, *Hochst. ex A. Rich. Tent. Fl. Abyss.* ii. 363.

Northern Melsetter, 4000–6000 ft. ; April ; n. 1602 *a* : Nyahodi River, 4000 ft. ; April ; n. 1673 : near Chirinda, 3500 ft. ; Jan. ; n. 1622 : Zinyumbo Hills, 1500 ft. ; Jan. ; n. 1557.

Distrib. Tropical Africa ; Natal.

P. NIGROPEDATUM, *Munro ex Ficalho & Hiern in Trans. Linn. Soc.* ser. 2, *Bot.* ii. (1881) 29.

Madanda forests about 400 ft. ; Dec. ; n. 1558 *a*.

Distrib. South Africa to Upper Zambesi.

P. NUDIGLUME, *Hochst. in Flora*, xxvii. (1844) 253.

Muchukwana, Lower Buzi, 400 ft. ; Dec. ; n. 997.

Distrib. Tropical Africa. A large form with pubescent spikelets.

P. TRICHOPUS, *Hochst. l. c.* 254.

Lower Buzi, 100–400 ft. ; Dec. ; nn. 971, 998, 1558.

Distrib. Tropical Africa ; Transvaal, Natal.

P. BOLBODES, *Schweinf. Beitr. Fl. Æthiop.* 300.

Northern Melsetter, 4000–6000 ft. ; April ; n. 1699.

Distrib. Tropical Africa.

P. SERRATUM, *Spreng.* var. HOLOSERICEUM, *Hack. ex Durand & Schinz, Consp. Fl. Afr.* v. 765.

Near Chirinda, 3800 ft. ; Jan. ; n. 1623.

Distrib. South Africa to Nyasaland.

P. ZIZANIOIDES, *H. B. K. Nov. Gen. & Spec.* i. 100.

Beira, open woods, 50 ft. ; Dec. ; n. 1596.

Distrib. West Africa ; India, Tropical America.

PANICUM INFESTUM, *Anderss. in Peters Mossamb. Bot.* ii. 546.
Lower Buzi, 100 ft.; Dec.; n. 972.
Distrib. East tropical Africa.

P. DREGEANUM, *Nees, Fl. Afr. Austr.* 42.
Beira, open woods, 50 ft.; Dec.; n. 1592.
Distrib. South Africa, Nyasaland.

PANICUM (§ Eu-panicum) SWYNNERTONII, *Rendle*, sp. nov.

Gramen culmis gracilibus ramosis (pars superior solum exstat); vagina sub inflorescentia sublaxa præter pilos marginales basi tuberculatos paucos glabra; ligula obsoleta; lamina lineari-acuminata margine incrassata basi ampliata; paniculæ rhachi tenui glabra, ramis filiformibus fastigiatis solitariis vel suboppositis iterum ramulosis, ramulis capillaribus secundis; pedicellis solitariis vel binatis inæqualibus; spiculis duris viridibus cæruleo-tinctis conspicue nervatis primum lanceolatis acutis; gluma I. late-ovata abrupte et breviter acuta 3-nervia spicula plus duplo breviore; gl. II. ovato-acuminata 5-nervia spiculum æquante; gl. III. late ovali 7-nervia paleam subæqualem et florem masculum fovente; gl. IV. cum flore fertili ovali glauca nitida.

Hab. Northern Melsetter, 2000–6000 ft.; April; n. 1702 *a*.

Culmus in parte superiore 1 mm. crass. vix excedens. Vagina suprema 5·5 cm. long.; lamina 8 cm. long., 4 mm. lat. Panicula 12 cm. long.; rami 8 cm. long., superne breviores; ramuli flexuosi superne diminuti. Spiculæ 2·5 mm. long. Gluma I. 1 mm., gl. II. 2·3 mm., gl. III. 2 mm., gl. IV. 1·75 mm. long.

A member of the *P. coloratum* group characterized by its hard, slender, very acute, distinctly nerved spikelets.

P. TRYPHERON, *Schult.*, var. GIGANTEUM, *Rendle in Welw. Cat. Afr. Pl.* ii. 181.
Near Chirinda, 3800 ft.; March; n. 1620 *a*. A tall grass.
Distrib. West tropical Africa.

P. MADAGASCARIENSE, *Spreng. Syst.* i. 317.
Northern Melsetter, 3000–6000 ft.; April; n. 1702: Lower Buzi, to 400 ft.; Dec.; n. 1568 *a*.
Distrib. Tropical Africa, Madagascar.

AXONOPUS SEMIALATUS, *Hook. f.*, var. ECKLONII, *Stapf in Dyer Fl. Cap.* vii. 418.
Melsetter, 6000 ft.; Oct.; n. 6034: Mt. Pene, 6500–7000 ft.; Sept., Oct.; nn. 1644, 6035: Beira; Dec.; n. 1597: Boma to Inyamita, Lower Buzi, 100 ft.; Dec.; n. 1583.
Distrib. Tropical and South Africa; Madagascar, India.

MELINIS MINUTIFLORA, *Beauv. Agrost.* 54.
Near Chirinda, 3500 ft.; n. 1694.
Distrib. South tropical Africa ; Natal ; Madagascar ; Brazil.

SETARIA NIGRIROSTRIS, *Durand & Schinz, Consp. Fl. Afr.* v. 774.
Northern Melsetter, 4000–6000 ft.; April; n. 1693.
Distrib. East tropical and South Africa.

S. MAURITIANA, *Spreng. Syst.* i. 305.
Chirinda forest outskirts, 3700–4000 ft.; April; n. 417.
Distrib. Wide spread in tropics. Native name "Izeya." The first vegetation to spring up after the destruction of the forest by the annual grass fires.

PENNISETUM HORDEIFORME, *Spreng. Syst.* i. 302.
Northern Melsetter, 3000–6000 ft.; April ; n. 1694.
Distrib. East tropical and South Africa.

P. PURPUREUM, *Schumach. in Dansk. Vidensk. Selsk.* iii. 64.
Northern Melsetter, 3000–6000 ft., and Lusitu River, 3000 ft.; April; n. 955.
Distrib. South-east tropical and West tropical Africa.

P. SETOSUM, *L. Rich. in Pers. Syn.* i. 72.
Upper Buzi, 3000–3500 ft.; April; n. 975 : Nyahodi River, 4000 ft ; April ; n. 1664.
Distrib. Tropical Africa.

P. LONGISETUM, *K. Schum. in Engl. Pfl. Ost-Afr.* C. 105.
Lusitu River, 3000 ft.; April : n. 1649 : Upper Buzi, 3000–3500 ft.; April ; n. 983 : near Chirinda, 3500 ft.; n. 414.
Distrib. Tropical Africa, Natal.

PŒCILOSTACHYS FLACCIDULA, *Stapf MS. in Herb. Kew.*
Gramen culmis nodosis foliosis e nodis basalibus ramosis et radicantibus, internodiis inferioribus brevibus et sparse pilosis, superioribus gradatim longioribus; vaginis laxis quam internodia sæpius brevioribus, margine exteriore et ore pilosis ; ligula truncata membranacea pilosa ; lamina intense-viride flaccidule-membranacea oblongo-lanceolata acuminata multinervia facie utraque pilis paucis appressis aspersa ; panicula sæpe secunda, ramis strictis rigidule patentibus distantibus superne diminutis ; spiculis geminis inæqualiter pedicellatis cum pedicello infra glumas articulatis lateraliter subcompressis lanceolatis acutis sparsius setosis ; glumis 3 exterioribus herbaceis acutis infertilibus ; gl. I. ovato-lanceolata 3-nervia quam spicula tertia parte breviore ; gl. II. lanceolata 5-nervia spicula paullo breviore;

gl. III. elliptica 7-nervia vel imperfecte 9-nervia spiculam æquante vacua vel florem masculum interdum plus minus abortivum fovente; flore fertili incluso breviter pedicellato, gluma coriacea lævi elliptica subacuta 5-nervia, palea glumam æquante coriacea.

Hab. Chipete forest patch, 3800 ft.; April; n. 409 *a*. A common low grass in forest. Also in Nyasaland.

Culmus cum panicula 8 dm. long.; internodia inferiora 2–3 cm. long., 2 mm. crass., superiora ad 5·5 cm. long. Ligula vix 1·5 mm. long.; laminæ ad 11·5 cm. long. et 2·2 cm. lat. Panicula 25 cm. long., internodio basali foliato; ramo infimo 7 cm. long. cum ramulo brevi basali. Spiculæ 6·5–7 mm. long.; pedicellus brevior 0·5–1 mm. long., longior 1·5–2·5 mm. long. Gl. I. 4·3–4·6 mm. long., II. circa 6 mm. long.; flos fertilis 4 mm. long.

An interesting addition to this genus, hitherto known only in two species from Madagascar. The African species differs in the more herbaceous character of the spikelets, which are moreover setose, the absence of the awn from the lowest barren glume, and the spreading branches of the panicle.

TRICHOLÆNA RHODESIANA, *Rendle*, sp. nov.

Gramen perenne habitu *T. setifoliæ*, Stapf, sed panicula gracili et spiculis minoribus et pro genere sparse pilosis distincta; culmis gracilibus cum innovationibus foliosis velut in *T. setifolia* aggregatis præter nodos pubescentes glabris binodis erectis vel interdum geniculatis; foliis anguste linearibus sæpissime convolutis glabris; vaginis basalibus persistentibus conspicue striatis et basi argenteo-pilosis, caulinis culmo arcte appressis, suprema ad basin paniculæ elongata; ligula brevissima dense setosa; panicula flexuosa contracta; rhachi tenui sparse albide-pilosa; ramis filiformibus solitariis, statim ramulum breviorem emittentibus; ramulis pedicellisque capillaribus plus minus pilosulis, præcipue in apice cupuliformi; spiculis argenteo-sericeis, pilis spiculam haud excedentibus; gl. I. subobsoleta dense pilosula; gl. II. subchartacea oblongo-lanceolata 5-nervia, ex apice vix emarginata breviter aristata, pilis marginalibus et linea transversali supra medium aggregatis; gl. III. primæ simili et æquali sed paullo angustiore et longius aristata, paleam subæqualem in nervis pilosulam cum flore masculo fovente; flore fertili oblonga, gluma membranacea obtusa glabra.

Hab. Near Chirinda Forest, 3700–4000 ft.; Nov.; n. 1632. A grass common in *Uapaca* groves. Nyahodi river at about 4000 ft.; April; n. 1663.

Planta 3·5–4·5 dm. alta; culmi vix ad 1 mm. crass. Vagina superior 7–11 cm. long., suprema 14–15 cm. long.; ligula 0·3 mm. long.; lamina vix 7 cm. longitudine excedens et 1·3 mm. lat. Panicula circa ·1 dm. long.; rami ad 2 vel 3 cm. long. Spicula sine aristis 4 mm. long.; gl. II. 4 mm. long., ejus arista 0·6 mm.; arista gl. III. 1·6 mm. long.; flos fertilis 2·5 mm. long.

Var. GLABRESCENS, *Rendle*, var. nov. Planta paullo robustior spiculis pallide rubridis paullo majoribus basi excepto glabrescentibus.

Hab. Northern Melsetter, 4000–6000 ft.; April; n. 1685.

Planta ad 5 cm. alta. Gl. II. et III. sæpe 4·5 mm. long., aristis 1 mm. et 2 mm. long., margine præter basin brevius pilosæ, ceterum sparse pilosulæ.

TRICHOPTERYX SIMPLEX, *Hack. ex Engl. Hochgebirgsfl. Trop. Afr.* 129.

Northern Melsetter, 4000–6000 ft.; in fr. April; nn. 1612, 1709: Nyahodi River, 4000 ft.; in fr. April; n. 1662: Chipetzana Source, 4000 ft.; in fr. April; n. 974: near Chirinda, 3700 ft.; in fl. Jan.; n. 1618.

Distrib. Tropical and South Africa.

TRISTACHYA BISERIATA, *Stapf in Kew Bull.* 1897, 295.

Northern Melsetter, 3000–6000 ft.; April; n. 1708.

Distrib. Angola, Basutoland.

T. LEUCOTHRIX, *Trin. ex Nees Agrost. Bras.* 460.

Mt. Pene, 6500–7000 ft.; Sept.; n. 1643.

Distrib. Cape Colony.

ARISTIDA BARBICOLLIS, *Trin. & Rupr. Stirp.* 152.

Northern Melsetter, 4000 ft.; April; n. 1717.

Distrib. South Africa.

SPOROBOLUS INDICUS, *R. Br. Prodr.* 170.

Near Chirinda, 3700 ft.; Jan.; n. 404.

Distrib. East tropical Africa; South Africa; Mascarene Is.; Australia.

S. FESTIVUS, *Hochst. ex A. Rich. Tent. Fl. Abyss.* ii. 398.

Zinyumbo Hills, 1500 ft.; Jan.; n. 1553.

Distrib. East tropical Africa; Transvaal, Natal.

S. CENTRIFUGUS, *Nees, Fl. Afr. Austr.* 158.

Mt. Pene, 6500–7000 ft.; Sept.; n. 1647. A low grass.

Distrib. South Africa; Nyasaland.

DIPLACHNE BIFLORA, *Hack.*, var. BUCHANANII, *Stapf in Dyer Fl. Cap.* vii. 593.

Near Chirinda, 3500 ft.; Jan.; n. 1619. A common grass.

Distrib. Basutoland.

There is a similar specimen in Herb. Kew from Namasi, collected by K. J. Cameron.

CRASPEDORHACHIS RHODESIANA, *Rendle*, sp. nov. (Pl. **5.** figs. 5–13.)

Gramen culmo glaberrimo terete gracili; vaginis internodiis brevioribus;

ligula brevissima membranacea; spicis tenuibus elongatis 8–9 secus rhachin communem parum distantibus, summis 2–3 confertis; spiculis sessilibus lineari-lanceolatis glabris secus rhachin marginatam arcte imbricatis; glumis 2 sterilibus subæqualibus membranaceis concavis acuminatis uninerviis, inferiore latiore et magis carinata (carina scabridula), rhachi contigua; gluma florente triplo breviore tenuissime hyalina glabra obsolete trinervia; palea gluma paullo breviore tenuissime hyalina glabra.

Hab. Northern Melsetter, 3000–6000 ft.; April; n. 1697.

Culmi internodium ultimum 1·5 mm. diam., vagina ejusdem 15 cm. long. Rhachis communis inflorescentiæ 6–9 cm. long. ad 1 mm. crass. Spicæ ad 14 cm. long., 1 mm. crass. Spiculæ 3 mm. long.; gluma fertilis 1 mm. long.

An interesting addition to this little genus, which has hitherto been known only from two species from the Zambesi; from both of these it is distinguished by the fewer and much longer spikes, which are also much slenderer than in *C. africana*. In size the spikelets are between those of *C. africana* and *C. Menyharthii*, Hack. The fertile glume and pale are also distinguished by the absence of hairs.

Chloris pycnothrix, *Trin. Gram. Unifl.* 234.
Near Chirinda, 3700 ft.; Oct., April; nn. 1629 *a*, 1696.
Distrib. South-east tropical Africa; Natal; South America.

C. abyssinica, *Hochst. ex A. Rich. Tent. Fl. Abyss.* ii. 406.
Northern Melsetter, 4000–6000 ft.; April; n. 1700.
Distrib. East tropical Africa.

Leptocarydion alopecuroides, *Stapf in Dyer Fl. Cap.* vii. 649.
Northern Melsetter, 3300–6000 ft.; April; n. 1695.
Distrib. East and West tropical Africa.

Pogonarthria falcata, *Rendle in Cat. Welw. Afr. Pl.* ii. 232.
Northern Melsetter, 3000–6000 ft.; April; nn. 1609, 1706: Nyahodi River, 4000 ft.; April; n. 1674 *a*: Upper Buzi, 3000–3500 ft.; April; nn. 978, 981, 982.
Distrib. Angola; South Africa to the Zambesi.

Eragrostis congesta, *Oliver in Trans. Linn. Soc.* xxix. (1875) 175.
Nyahodi River, 4000 ft.; April; n. 1665.
Distrib. East tropical Africa.

E. plana, *Nees, Fl. Afr. Austr.* 390.
Melsetter, 6000 ft.; April; n. 1681: near Chirinda, 3500 & 3700 ft.; Nov., Jan.; nn. 404 *a*, 968, 1626.
Distrib. South Africa.

ERAGROSTIS HIERNIANA, *Rendle in Cat. Welw. Afr. Pl.* ii. 237.
Beira, 50 ft.; Dec.; n. 1591 *a*.
Distrib. Angola.

E. CHAPELIERI, *Nees, Fl. Afr. Austr.* 392.
Northern Melsetter, 3000–6000 ft.; n. 1707: Nyahodi River, about 4000 ft.; n. 1674: Upper Buzi, 3000–3500 ft.; n. 980; April.
Distrib. Tropical Africa; Natal; Mascarene Islands.

E. BRIZOIDES, *Nees, in Linnæa,* vii. (1832) 328.
Mt. Pene, about 6500 ft.; Sept.; n. 1646.
Distrib. South Africa.

E. NAMAQUENSIS, *Nees, Ind. Sem. Vratisl.* 1835.
Northern Melsetter, 4000–6000 ft.; April; n. 1608.
Distrib. Tropical and South Africa.

CENTOTHECA MUCRONATA, *Hack. in Journ. Linn. Soc., Bot.* xxix. (1891) 66.
Madanda forests, 400 ft.; Dec.; n. 1559.
Hab. East and West tropical Africa; Madagascar.

LEPTASPIS COCHLEATA, *Thw. Enum. Pl. Zeyl.* 357.
Chirinda, 3700–4000 ft.; Dec., Jan.; nn. 410, 419, 6633. One of the commonest herbs in the forest, in many parts carpeting the whole ground.
Distrib. West tropical Africa; Comoro Islands; Ceylon.

OXYTENANTHERA ABYSSINICA, *Munro in Trans. Linn. Soc.* xxvi. (1868) 127.
Beira, open woods at 50 ft.; Dec.; n. 962.
Distrib. Tropical Africa.

GYMNOSPERMS.

By Dr. A. B. RENDLE.

PODOCARPUS MILANJIANA, *Rendle in Trans. Linn. Soc.* ser. 2, *Bot.* iv. (1894) 61.
Chimanimani Mts., 7000 ft.; male fl. Sept.; n. 1962; common as a sapling, no old trees seen. Mt. Pene, 7000 ft.; n. 6038; a number of well-grown specimens seen, height 40 ft. and 2 ft. or more in diameter.
Distrib. South-East tropical Africa.

WIDDRINGTONIA WHYTEI, *Rendle, l. c.* 60, t. 9.
W. Mahoni, Masters in Journ. Linn. Soc., Bot. xxxvii. (1905) 271.
Chimanimani Mts., 7000 ft.; n. 1964: Melsetter, 6000 ft.; in fr. Sept.; n. 1963.
Distrib. Nyasaland.

A medium-sized or, occasionally, large tree; it seldom appears to reach a really large size except in very sheltered glens or on the edges of forest patches. The bark is light reddish brown, soft and dry externally and resinous. The tree begins to fruit at a very early age. The cones usually grow in heavy and conspicuous clusters on the young leader or near the ends of the smaller side-twigs; they vary in size and robustness, the larger averaging $\frac{3}{4}$ in. in length by $\frac{3}{5}$ in. broad, while the smaller do not exceed $\frac{1}{2}$ in. in length. It is by far the best local timber—light, handsome, easily worked, scented, and very durable.

Mr. Swynnerton's observations are of special interest as bearing on the colour of the young leaves by which the Rhodesian specimens have been distinguished from the Milanji cedar, the foliage in the young state being of a dull dark green without the bluish-green hue so remarkable in young specimens of the Milanji cedar (see Masters, *l. c.*, and Rendle in Journ. Bot. xliv. (1906) 193). Mr. Swynnerton says:—"During my visit to Northern Melsetter and the Chimanimani Mountains in 1906, I had the opportunity of examining a very large number of the trees, both old and young, in the wild state, and can assert that though the bluish tinge mentioned by Mr. Mahon is sometimes absent in the latter, it is very frequently present, and sometimes in a very marked degree. Out of 55 young trees planted by myself three years before from Melsetter seed, all in flourishing condition, not one lacked it, and even now, $2\frac{1}{2}$ years later, the majority still show it more or less conspicuously. These are on a very poor washed-out slope. On the other hand, out of a dozen or more trees of the same age planted on richer soil by one of my neighbours, at roughly the same elevation and in an equally flourishing condition, only two possessed it, the remainder being of the dark green hue described by Mr. Mahon. In the wild state I have noticed both types, but am unable to say which is the more frequent; I think, on the Chimanimani at any rate, the bluish, and these were, I should say, on distinctly poor soil (apart from such benefit from humus as the trees might derive from standing on the outskirts of forest patches—their most usual situation). It is therefore probable that the presence or absence of the bluish tinge is dependent simply on soil.

"Comparatively few 'cedars' are found inside the forests, though in one such spot, beside a stream, I noted a fairly compact group of thirteen good, straight, single-stemmed specimens (as well as many younger), the largest number I have seen growing together in one place. Groups of three or four are not infrequent, and large numbers of seedlings may sometimes be seen growing together in a densely-packed mass—to be thinned out later, presumably, by fires. It is probably due to these annual grass-fires that the habitat of the species is so restricted. Even in Southern Melsetter (3000–4000 ft.) it flourishes exceedingly wherever planted, and is doubtless excluded from this district in its wild state solely by the far ranker growth

there of the grass, resulting in severer fires. Even on the Chimanimani range, where the grass is extremely short, the trees have suffered greatly.

"The tree grows not uncommonly between 5500–7000 and probably 8000 ft. on the higher hills about Melsetter and along the Portuguese border between that place and the Umvumvumvu river, as well as on the Chimanimani range and on the higher spurs of the mountains between Mount Pene and the Yanganda headwaters—almost entirely in the glens, along the streams, on the edges of patches of forest, on sheer scarps or amongst rocks—anywhere, in fact, where there is some slight protection from the full force of the grass-fires."

CRYPTOGAMS.

By A. Gepp, M.A., F.L.S.

PTERIDOPHYTA.

Gleichenia polypodioides, *Sm. in Mém. Ac. Turin*, v. 419 (1793).
Chimanimani Mts., 6500 ft. ; n. 676.
Distrib. South Africa, Amsterdam Island.

Gleichenia umbraculifera, *T. Moore, Ind. Filicum*, 384 (1862).
Melsetter, 6000 ft., n. 613; Lusitu Hills, 5000 ft., n. 1497.
Distrib. South Africa.

Cyathea Dregei, *Kunze in Linnæa*, x. (1836) 551.
Mt. Pene Forest, 6500–7000 ft. ; n. 816.
Distrib. South and East Africa.

Cyathea Thomsoni, *Baker in Journ. Bot.* xix. (1881) 180.
Near Chirinda, 3800 ft. ; n. 817, n. " Z," n. 401 in part.
Distrib. Nyasaland.

Cyathea Manniana, *Hook. Syn. Filicum*, 21 (1865).
Maruma, 3700 ft., n. 801 ; Mt. Pene, 7000 ft., n. 6030.
Distrib. West and East tropical Africa.

Hymenophyllum gracile, *Bory in Willd. Sp. Pl.* v. 527 (1810).
Mt. Pene, 7000 ft.; n. 6016.
Distrib. Natal, Madagascar, Mascarene Islands.

Davallia thecifera, *H. B. K. Nov. Gen. et Sp.* i. 23 (1815).
Mt. Pene, S.E. Rhodesia, 7000 ft.; n. 6018.
Distrib. South America, Africa, African Islands.

HYPOLEPIS ANTHRISCIFOLIA, *Presl, Tentamen*, 162 (1836).
Chirinda Forest, 3700–4000 ft. ; n. 820.
Distrib. Mascarene Islands, South Africa, Fernando Po.

HYPOLEPIS BERGIANA, *Hooker, Sp. Filicum*, ii. 67 (1852).
Chimanimani Mts., 7000 ft. ; n. 821.
Distrib. Cape Colony to Zambesi.

PELLÆA INVOLUTA, *Baker, Syn. Filicum*, ed. 2, 148 (1874).
Common on ant-heaps, Madanda forests, 400 ft. ; n. 882.
Distrib. South Africa.

PELLÆA CONSOBRINA, *Hooker, Sp. Filicum*, ii. 145 (1858).
Chimanimani Mts., 7000 ft., n. 852 ; Mt. Pene, 7000 ft., n. 6028.
Distrib. South, West, and East Africa, and Mascarene Islands.

PELLÆA HASTATA, *Link, Filicum Sp.* 60 (1841).
Inyamadzi Valley, 2500 ft., n. 848 ; Madanda forests, 400 ft., n. 847.
Distrib. South, West, and East Africa, and Mascarene Islands.

Var. MACROPHYLLA, *Hooker, Sp. Filicum*, ii. 146 (1858). Chirinda Forest, 3600-4000 ft., n. 800 ; Inyamadzi Valley, 2500 ft., n. 849.
Distrib. As the type.

PELLÆA CALOMELANOS, *Link, Filicum Sp.* 61 (1841).
Near Chirinda, 3600 ft. ; n. 850.
Distrib. South, West, and East Africa, Bourbon, Himalayas, Yunnan.

PTERIS CRETICA, *Linn. Mant.* 130 (1767).
Chirinda Forest, 3700–4000 ft. ; n. 831.
Distrib. Wide.

PTERIS QUADRIAURITA, *Retz. Obs. Bot.* vi. 36 (1791).
Chirinda Forest, 3700–4000 ft. ; n. 872.
Distrib. Wide.

PTERIS BREVISORA, *Baker, Syn. Filicum*, 162 (1867).
Chirinda Forest, 3700–4000 ft.; n. 871.
Distrib. West Africa, Zambesi.

PTERIS AQUILINA, *Linn.*, var. LANUGINOSA, *Hooker, Sp. Filicum*, ii. 196 (1858).
Chirinda, 2800 ft., n. 401 in part ; Mt. Pene, 7000 ft., n. 6029.
Distrib. Wide.

LOMARIA ATTENUATA, *Willd. Sp. Pl.* v. 290 (1810).
Chimanimani Mts., 7000 ft., n. 835 *a*; Mt. Pene, 7000 ft., nn. 6023 & 6024.

LOMARIA PROCERA, *Spreng. Syst. Veget.* iv. 65 (1827).
Chirinda Forest, 3700–4000 ft. ; n. 832.
Distrib. Wide.

LOMARIA BORYANA, *Willd. Sp. Pl.* v. 292 (1810).
Chimanimani Mts., 7000 ft., n. 835 ; Mt. Pene, 7000 ft., n. 6022.
Distrib. South America, Africa.

ASPLENIUM ERECTUM, *Bory in Willd. Sp. Pl.* v. 328 (1810).
Chirinda Forest, 3700–4000 ft., n. 827 ; Mt. Maruma, 3500 ft., n. 839.
Distrib. Africa.

ASPLENIUM SERRA, *Langs. et Fisch.*, var. NATALENSIS, *Baker, Syn. Filicum*, ed. 2, 485 (1874).
Chimanimani Mts., 6500 ft.; n. 851.
Distrib. Natal. The type in South America and West Africa.

ASPLENIUM GEMMIFERUM, *Schrad. in Götting. gel. Anzeig.* (1818) 916.
Chirinda Forest, 3700–4000 ft. ; nn. 402 & 853.
Distrib. South, West and East Africa, and Mascarene Islands.

Var. LACINIATUM, *Mett. in Kuhn, Filices Africanæ*, 103 (1868). Chirinda Forest, 3700–4000 ft.; nn. 844 & 844 *a*.
Distrib. South Africa.

ASPLENIUM RESECTUM, *Smith, Pl. Icon. Inedit.* iii. t. 72 (1791).
Chirinda Forest, 3700–4000 ft. ; nn. 840 *a* & 841.
Distrib. West Africa to Japan and Polynesia.

ASPLENIUM LÆTUM, *Swartz, Syn. Filicum*, 79, 271 (1806).
Chirinda Forest, 3700–4000 ft. ; nn. 840 & 840 *b*.
Distrib. South Africa, Madagascar, South America.

ASPLENIUM PROTENSUM, *Schrad. in Götting. gel. Anzeig.* (1818) 916.
Chirinda Forest, 3700–4000 ft. ; nn. 879 & 880.
Distrib. Tropical and South Africa, and Mascarene Islands.

ASPLENIUM FURCATUM, *Thunb. Prod. Fl. Cap.* 172 (1800).
Chirinda Forest, 3700–4000 ft., n. 845, and "D" ; Chimanimani Mts., 7000 ft., n. 846 *a* ; Melsetter, 6000 ft., n. 808; Mt. Pene, 7000 ft., n. 6026.
Distrib. Wide.

Var. TRIPINNATUM, *Baker, Syn. Filicum*, ed. 2, 487 (1874). Mt. Pene Forest, 6500–7000 ft. ; nn. 846 & 6027.
Distrib. South Africa.

ASPLENIUM CICUTARIUM, *Sw.*, var. ABYSSINICUM, *Baker, Syn. Filicum*, 220 (1867).
Chirinda Forest, 3700–4000 ft. ; n. 819.
Distrib. Tropical Africa.

ASPLENIUM MANNII, *Hooker, Second Century of Ferns*, t. 60 (1861).
Mt. Pene, 7000 ft., n. 6015 ; Chipete forest patch, 3800 ft., n. 427.
Distrib. Tropical Africa and Madagascar.

ASPLENIUM THUNBERGII, *Kunze in Linnæa*, x. (1836) 517.
Chirinda Forest, 3700–4000 ft., n. 806 ; Chipetzana head-waters, Mafusi, 4000 ft., n. 807 ; Mt. Pene, 7000 ft., n. 6017.
Distrib. South Africa.

DIDYMOCHLÆNA LUNULATA, *Desv. Prod. fam. Fougères*, 282 (1827).
Mt. Pene Forest, 6500–7000 ft. ; n. 815.
Distrib. South Africa to Polynesia, and South America.

ASPIDIUM AMMIFOLIUM, *Poiret in Lam. Encycl. Méthod.* v. 554 (1804).
Mt. Pene Forest, 6500–7000 ft., n. 878 ; Mt. Pene, 7000 ft., nn. 6031 & 6032.
Distrib. Natal, Cape, Mascarene Islands.

NEPHRODIUM ALBOPUNCTATUM, *Desv. Prod. fam. Fougères*, 255 (1827).
Chimanimani Mts., 7000 ft. ; n. 857.
Distrib. Tropical Africa, Mascarene Islands, Amboina, Fiji.

NEPHRODIUM BERGIANUM, *Baker, Syn. Filicum*, 269 (1867).
Inyamadzi Valley, 2500 ft., n. 863 ; Kurumadzi River, Jihu, 2000 ft., n. 862 pro parte ; Chirinda Forest, 3700–4000 ft., nn. 866 & 870.
Distrib. South Africa.

NEPHRODIUM THELYPTERIS, *Strempel*, var. SQUAMULIGERA, *Schlechtend. Adumbr. Pl.* 23 (1825).
Near Chirinda, 3800 ft., nn. 858 & 859*a* ; Kurumadzi River, Jihu, 2000 ft., nn. 859 & 862 (in part).
Distrib. South and East Africa.

NEPHRODIUM FILIX-MAS, *Rich.*, var. ELONGATUM, *Hooker, Sp. Filicum*, iv. 117 (1862).
Near Chirinda, 3800 ft.; nn. 874 & 457.
Distrib. Africa, East Indies, Southern United States.

NEPHRODIUM ATHAMANTICUM, *Hooker, Sp. Filicum*, iv. 125 (1862).

Often growing in the holes of ant-bears and jackals, and hence providing a valuable danger-signal of pitfalls to equestrians. Near Chirinda, 3800 ft., nn. 875 & 876; Lusitu River, 3000 ft., n. 875 *a*.

Distrib. South Africa.

NEPHRODIUM UNITUM, *R. Br. Prod.* 148 (1810).

Mt. Maruma, 3500 ft., n. 860; Kurumadzi River, Jihu, 2000 ft., n. 861.

Distrib. Very wide.

NEPHRODIUM MOLLE, *R. Br. Prod.* 149 (1810).

Chirinda Forest, 3700–4000 ft., nn. 864, 865, 867, 870; near Chirinda, 3800 ft., nn. 868 & 869; Kurumadzi River, Jihu, 2000 ft., n. 862 *a*.

Distrib. Very wide.

NEPHRODIUM CICUTARIUM, *Baker, Syn. Filicum*, 299 (1867).

Gemmiferous. Chirinda Forest, 3700–4000 ft., n. 823; Inyamadzi Valley, 2500 ft., n. 824; Mt. Pene, 6500–7000 ft., n. 824 *a*.

Distrib. Very wide.

NEPHROLEPIS CORDIFOLIA, *Presl*, var. UNDULATA, *Mett. in Kuhn, Filices Africanæ*, 156 (1868).

Chirinda Forest, 3700–4000 ft.; n. 856.

Distrib. Tropical Africa, and Comoro Islands.

POLYPODIUM PROLIFERUM, *Roxb. in Wall. List*, n. 312 (1828).

Fronds creeping among boulders at river's edge and rooting here and there. Inyamadzi Valley, 2500 ft.; n. 855.

Distrib. Angola to New Caledonia.

POLYPODIUM INCANUM, *Sw. Prod.* 131 (1788).

Chirinda Forest, 3700–4000 ft.; n. 809.

Distrib. United States to Chile and Argentina; South Africa.

POLYPODIUM AFRICANUM, *Mettenius, Ueb. einig. Farngattung*, I. Polypodium, 131 (1857).

Chirinda Forest, 3700–4000 ft., n. 425; Chipete forest patch, 3800 ft., n. 425 *a*.

Distrib. South and West Africa.

POLYPODIUM LEPIDOTUM, *Willd. in Schlechtend. Adumbr. Filicum.* 17 (1825).

Epiphytic on *Brachystegia Randii* and other trees. Melsetter, 6000 ft.,

n. 811; Chipete forest patch, 3800 ft., n. 812; Chimanimani Mts. 7000 ft., n. 813; Mt. Pene, 7000 ft., nn. 6008 & 6019.

Distrib. India to Africa and South America.

POLYPODIUM PHYMATODES, *Linn. Mant.* 306 (1771).

Almond-scented, growing among boulders at river's edge. Lusitu River, 2500 ft.; nn. 661 & 884.

Distrib. Polynesia to Malayan Islands and Africa.

GYMNOGRAMME ARGENTEA, *Mett. in Kuhn, Filices Africanæ*, 59 (1868).

In crannies of crags. Chimanimani Mts., 7000 ft.; n. 677.

Distrib. Natal and Mascarene Islands.

GYMNOGRAMME LANCEOLATA, *Hooker, Sp. Filicum*, v. 156 (1864).

Near Chirinda, 3800 ft., n. 814; Mt. Pene, 7000 ft., n. 6020.

Distrib. Polynesia and Japan to Africa.

VITTARIA ISOETIFOLIA, *Bory, Voyage*, ii. 325 (1804).

Chimanimani Mts., 7000 ft.; n. 802.

Distrib. South Africa, Bourbon.

ACROSTICHUM LATIFOLIUM, *Sw. Prod.* 128 (1788).

Mt. Pene, 7000 ft.; n. 6009.

Distrib. Natal, South America.

ACROSTICHUM LINEARE, *Fée, Mém.* ii. *Acrost.* 47 (1845).

Mt. Pene, 7000 ft.; n. 6014.

Distrib. Bourbon, Brazil.

ACROSTICHUM VISCOSUM, *Sw. Syn. Filicum*, 10, 193 (1806).

Chimanimani Mts., 7000 ft.; n. 810.

Distrib. South America to Africa, India and Malay Islauds.

ACROSTICHUM HEUDELOTII, *Hooker, Sp. Filicum*, v. 264 (1864).

Growing in stream; Inyamkuwha River, Mafusi, Chinambogé Valley, 3000 ft.; n. 833. Growing in and beside the water; common; Kurumadzi River, Jihu, 2000 ft.; n. 834.

Distrib. Senegambia, Sierra Leone, Zambesiland.

ACROSTICHUM AUREUM, *Linn. Sp. Pl.* 1069.

Limestone forest patch, Idunda River, Lower Buzi, 100 ft.; n. 838.

Distrib. Very wide.

OSMUNDA REGALIS, *Linn. Sp. Pl.* ii. 1065.

In swift stream, near Chirinda, 3700 ft. ; n. 828. Beside stream, Chipetzana head-waters, Mafusi, 4000 ft.

Distrib. Very wide.

TODEA AFRICANA, *Willd. in Schrift. Akad. Wiss. Erfurt*, i. (1802) 14.

Forming dense clumps along ledges of cliffs, Chimanimani Mts., 7000 ft. ; n. 830.

Distrib. South Africa, Australasia.

MOHRIA CAFFRORUM, *Desv. Prod. fam. Fougères*, 198 (1827).

Melsetter, 6000 ft. ; n. 611.

Distrib. South Africa to Mauritius.

MOHRIA LEPIGERA, *Baker, in Ann. Bot.* v. (1891) 498.

Chimanimani Mts., 7000 ft. ; n. 611 *a*.

Distrib. Zambesiland.

LYGODIUM SUBALATUM, *Bojer, in Kuhn, Filices Africanæ*, 170 (1868).

Handsome climbing fern, often completely enveloping patches of dense bush. Lower Zona River, Jihu, 2000 ft. ; n. 208.

Distrib. East tropical Africa, Comoro Islands, Madagascar.

MARATTIA FRAXINEA, *Sm. Pl. Icon. Inedit.* ii. t. 48 (1790).

Chirinda Forest, 3700–4000 ft., n. 826 ; Mt. Pene Forest, 6500–7000 ft., nos. 826 *a* & 6025.

Distrib. Africa to India and Polynesia, and to New Zealand.

EQUISETUM RAMOSISSIMUM, *Desf. Fl. Atlant.* ii. 398 (1800).

Forming thickets by the water's edge ; Inyamadzi Valley, 2500 ft. ; n. 780.

Distrib. Cosmopolitan in warm temperate and tropical zones.

LYCOPODIUM VERTICILLATUM, *Linn. f. Suppl. Syst. Veg.* ed. xiii. 448 (1781).

Fairly common in damp places ; Mt. Pene, 7000 ft. ; n. 6010.

Distrib. Tropical America, Polynesia, South Africa, Mascarene Islands.

LYCOPODIUM CERNUUM, *Linn. Sp. Pl.* ed. ii. 1566 (1763).

Trailing plant growing by the side of a water-furrow ; near Chirinda, 3800 ft. ; n. 458.

Distrib. Cosmopolitan in tropics and subtropics.

LYCOPODIUM CLAVATUM, *Linn.*, var. INFLEXUM, *Spring, Monogr. Fam. Lycopod.* i. 90 (1842).
Common in Mt. Pene Forest, 6500–7000 ft. ; n. 805.
Distrib. Cape and Madagascar.

SELAGINELLA RUPESTRIS, *Spring, in Endlich. et Mart. Fl. Bras.* i. 118 (1840).
Chimanimani Mts., 7000 ft. ; n. 617 *a*.

SELAGINELLA KRAUSSIANA, *A. Br. in Ind. Sem. Hort. Berol.* (1859) 22.
Chimanimani Mts., 7000 ft., n. 803 ; Mt. Pene, 7000 ft., n. 6013.

BRYOPHYTA.

CATHARINEA ANDROGYNA, *C. Muell. Syn. Musc.* i. 193 (1849).
Mt. Pene, 7000 ft. ; n. 6021.
Distrib. South Africa.

THAMNIUM AFRUM, *C. Muell. in Hedwigia*, xxxviii. (1899) 129.
On rock near Zona River, Jihu ; without number.
Distrib. South and East Africa.

MADOTHECA CAPENSIS, *Gottsche, Syn. Hepat.* 270 (1845).
On trees ; Chirinda, 3800 ft. ; n. 812.
Distrib. South, West, and East Africa, and South America.

FUNGI.

UNCINULA INCRASSATA, *E. S. Salmon, in Annales Mycologici*, vi. (1908) 525.
On leaves of *Pterocarpus mellifer* ; Zona River, Jihu, 2000 ft. ; without number.
Distrib. Gazaland.

LICHENES.

USNEA LONGISSIMA, *Ach. Lich. Univ.* 626 (1810).
Hanging from branches of trees, frequent ; Chirinda Forest, 3800 ft. ; n. 430. Chimanimani Mts., 6500 ft. ; n. 617. Madanda forests, 400 ft. ; nn. 801 & 1804.
Distrib. Very wide.

PHYSCIA FLAVICANS, *DC. Fl. Franç.* ii. 189 (1805).
On trees ; near Chirinda, 3800 ft. ; n. 883.
Distrib. Very wide.

EXPLANATION OF THE PLATES.

Plate 1.

(1) *Chrysophyllum fulvum*, S. Moore, in the Spungabera Forest.

(2) A group of *Khaya nyasica*, Stapf, on the outskirts of the Chirinda Forest.

(3) Base of tree of *Khaya nyasica*.

(4) A tree of *Adina microcephala* var. *Galpini*, Hiern, in the Inyamadzi Valley.

The great size of the tree can be judged from the figure of a native bearing a load in the right-hand corner.

Plate 2.

Figs. 1–5. *Teclea Swynnertonii*, Bak. fil. 1. A flowering branch (nat. size). 2. Female flower, × 6. 3. Ovary and stigma, × 6. 4. Ovary in transverse section, × 6. 5. Male flower, × 6.

Figs. 6 & 7. *Schefflerodendron gazense*, Bak. fil. 6. A flower (nat. size). 7. Standard (nat. size).

Plate 3.

Lovoa Swynnertonii, Bak. fil.

Fig. 1. A flowering branch (nat. size). 2. A leaf, × $\frac{1}{3}$. 3. A leaflet (nat. size). 4. A flower, × 9. 5. Staminal tube, × 9. 6. Portion of staminal tube seen from within, showing insertion of stamens, × 9. 7. Capsule (nat. size). 8. Winged seed (nat. size).

Plate 4.

Figs. 1–4. *Heinsenia sylvestris*, S. Moore. 1. A flowering branch (nat. size). 2. Corolla opened longitudinally, × $1\frac{1}{2}$. 3. Ovary, style and style-arms, × 3. 4. Ovary opened showing the two ovule-like pendulous placentas, × $3\frac{1}{2}$.

Figs. 5 & 6. *Heinsenia Brownii*, S. Moore. 5. Ovary opened, showing placenta, × 10. 6. Semidiagrammatic view of placenta in radial longitudinal section, showing the two embedded ovules (*pl.* placenta, *ov.* ovules), × 30.

Plate 5.

Figs. 1–3. *Humea africana*, S. Moore. 1. Part of plant (nat. size). 2. A capitulum, × 8. 3. A floret, × 8.

Fig. 4. *Swynnertonia cardinea*, S. Moore. A flower, × 4 (from a sketch of Mr. Swynnerton's from the living plant).

Figs. 5–13. *Craspedorhachis rhodesiana*, Rendle. 5. Portion of inflorescence (nat. size). 6. Portion of a spike, × 10. 7, 8. Outer barren glume, × 15. 9, 10. Inner barren glume, × 15. 11. Fertile glume, × 15. 12. Pale, × 15. 13. Flower showing fertilized ovary, × 40.

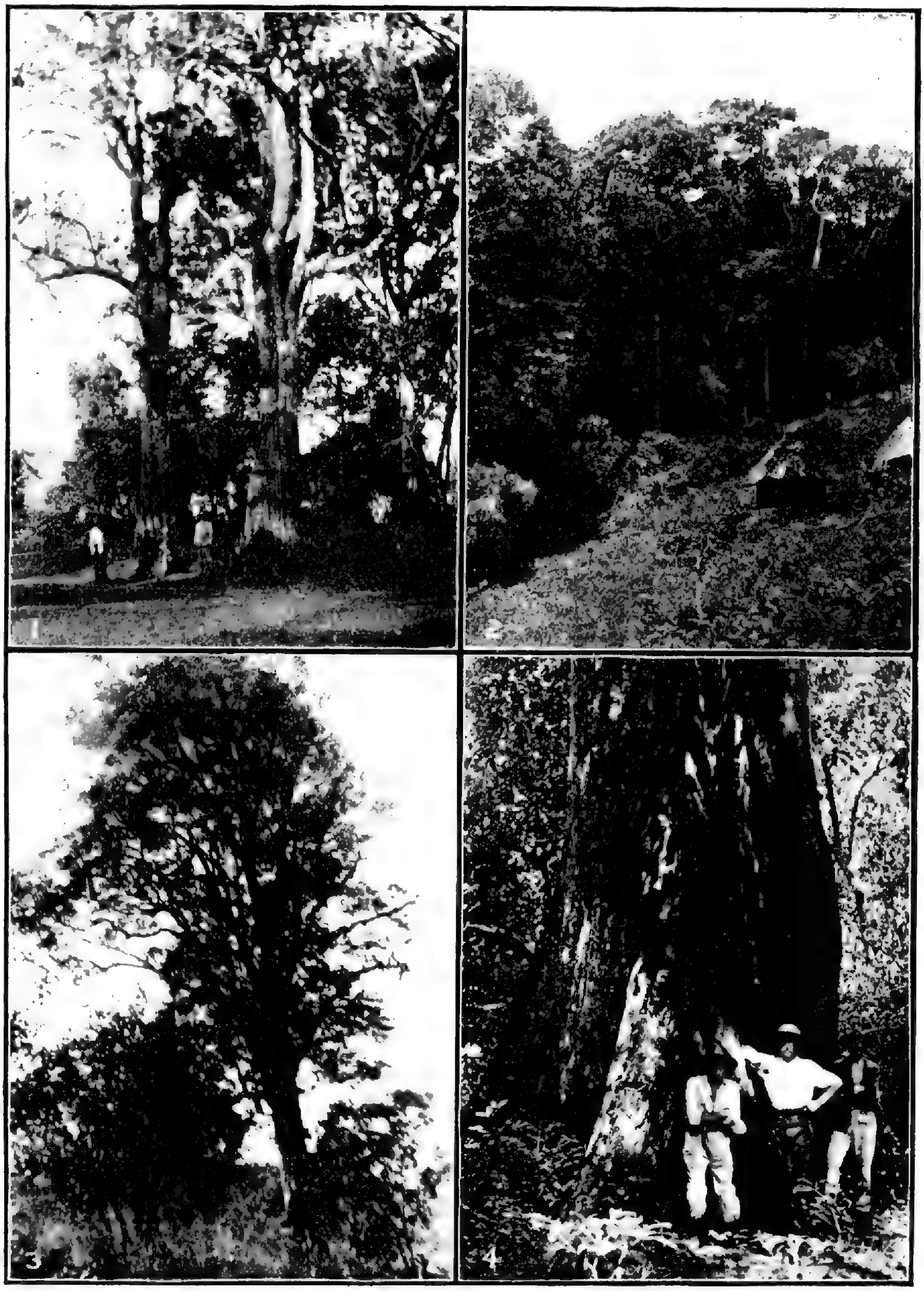
Plate 6.

Figs. 1–5. *Digitaria gazensis*, Rendle. 1. Plant (nat. size). 2. Portion of a spike, × 10. 3, 4. Barren glumes, × 16. 5. Fertile glume, × 16.

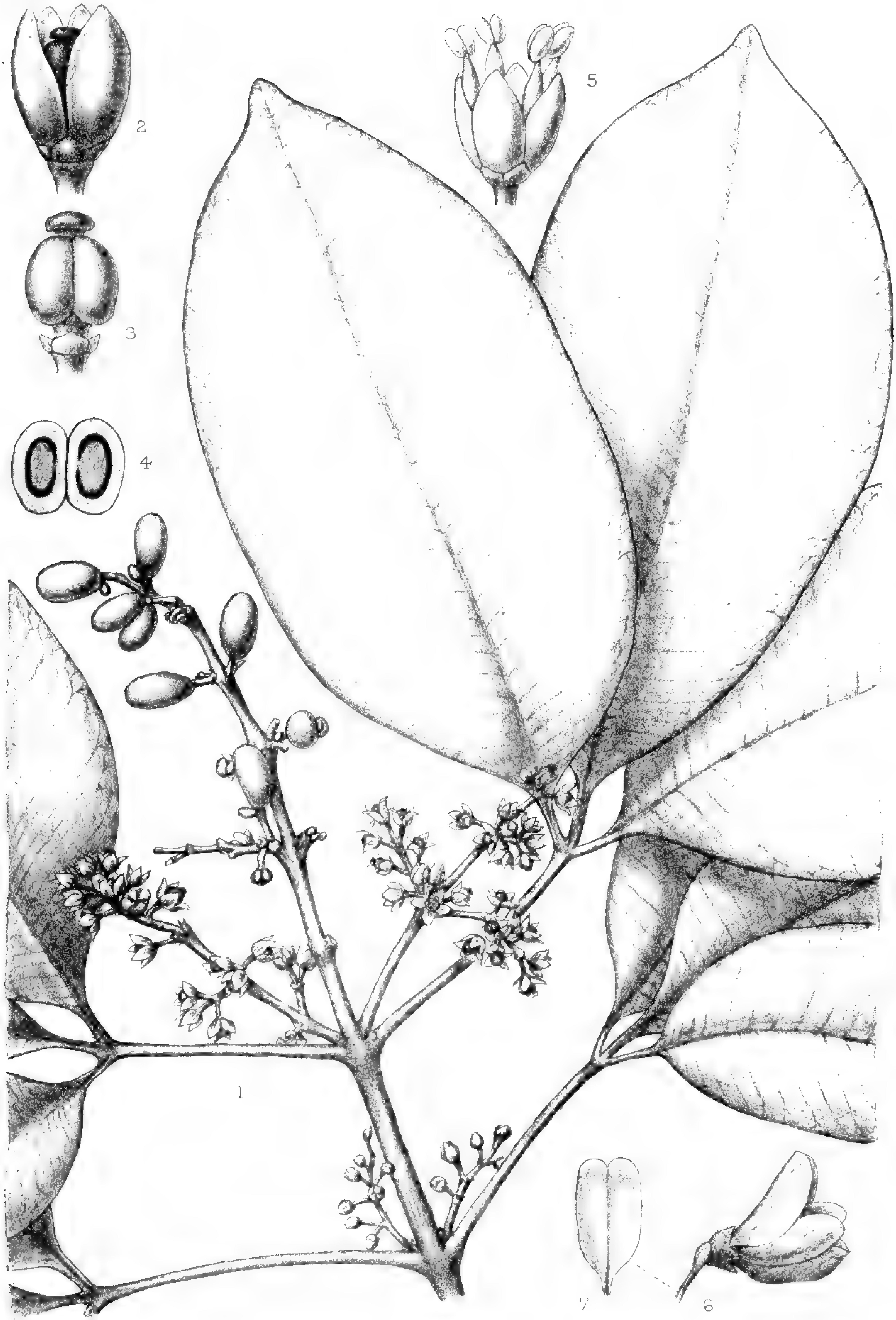
Figs. 6–10. *D. Swynnertonii*, Rendle. 6. Inflorescence (nat. size). 7. Portion of a spike, × 10. 8, 9. Barren glumes, × 16. 10. Fertile glume, × 16.

Plate 7.

Map of North-West Gazaland, showing Mr. Swynnerton's chief collecting districtt, adapted from his map published in 'The Ibis,' 1908.



VEGETATION OF GAZALAND.



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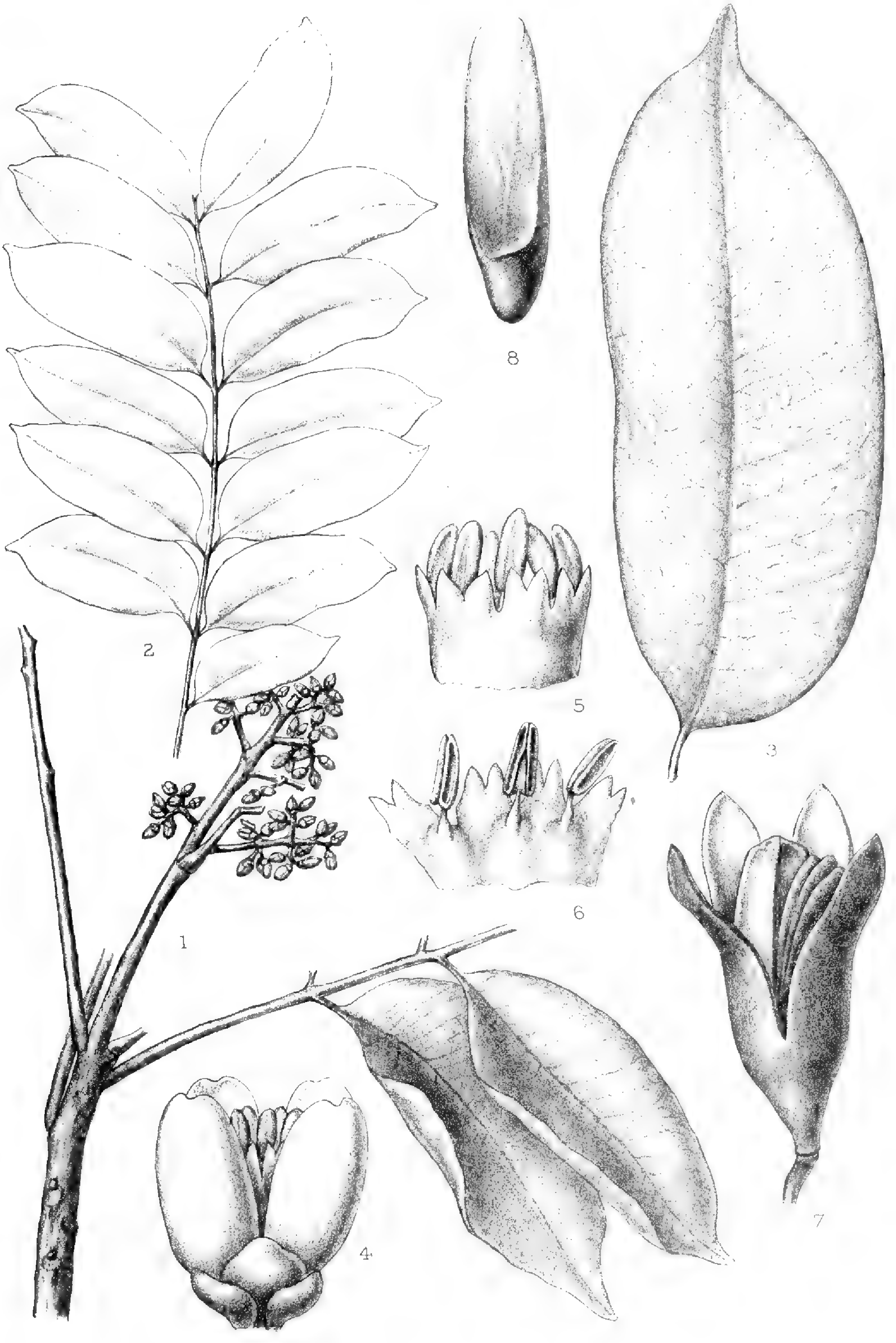
1–5, TECLEA SWYNNERTONII, *Bak. fil.*
6–7, SCHEFFLERODENDRON GAZENSE, *Bak. fil.*



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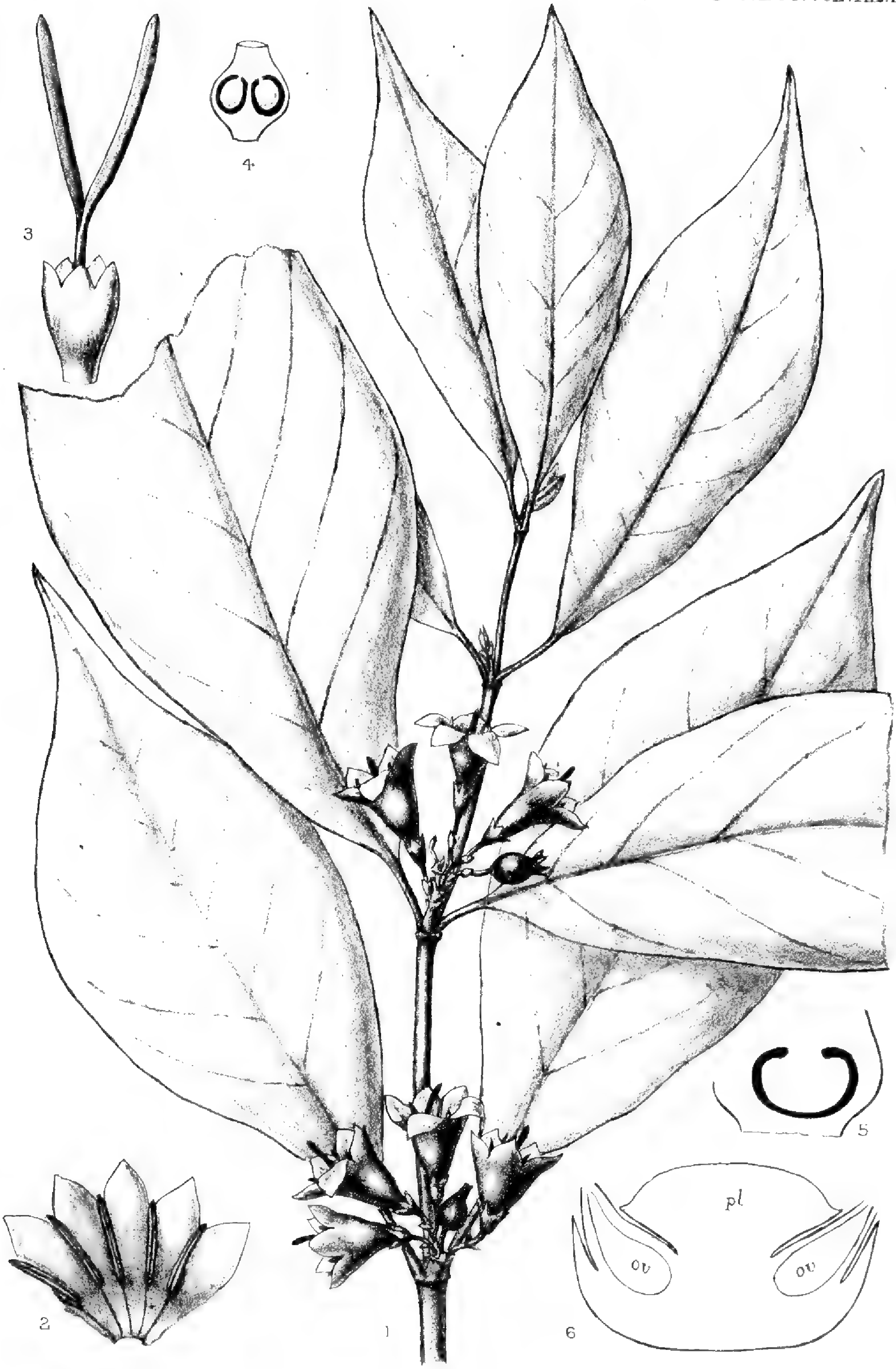
LOVOA SWYNNERTONII, *Bak. fil.*



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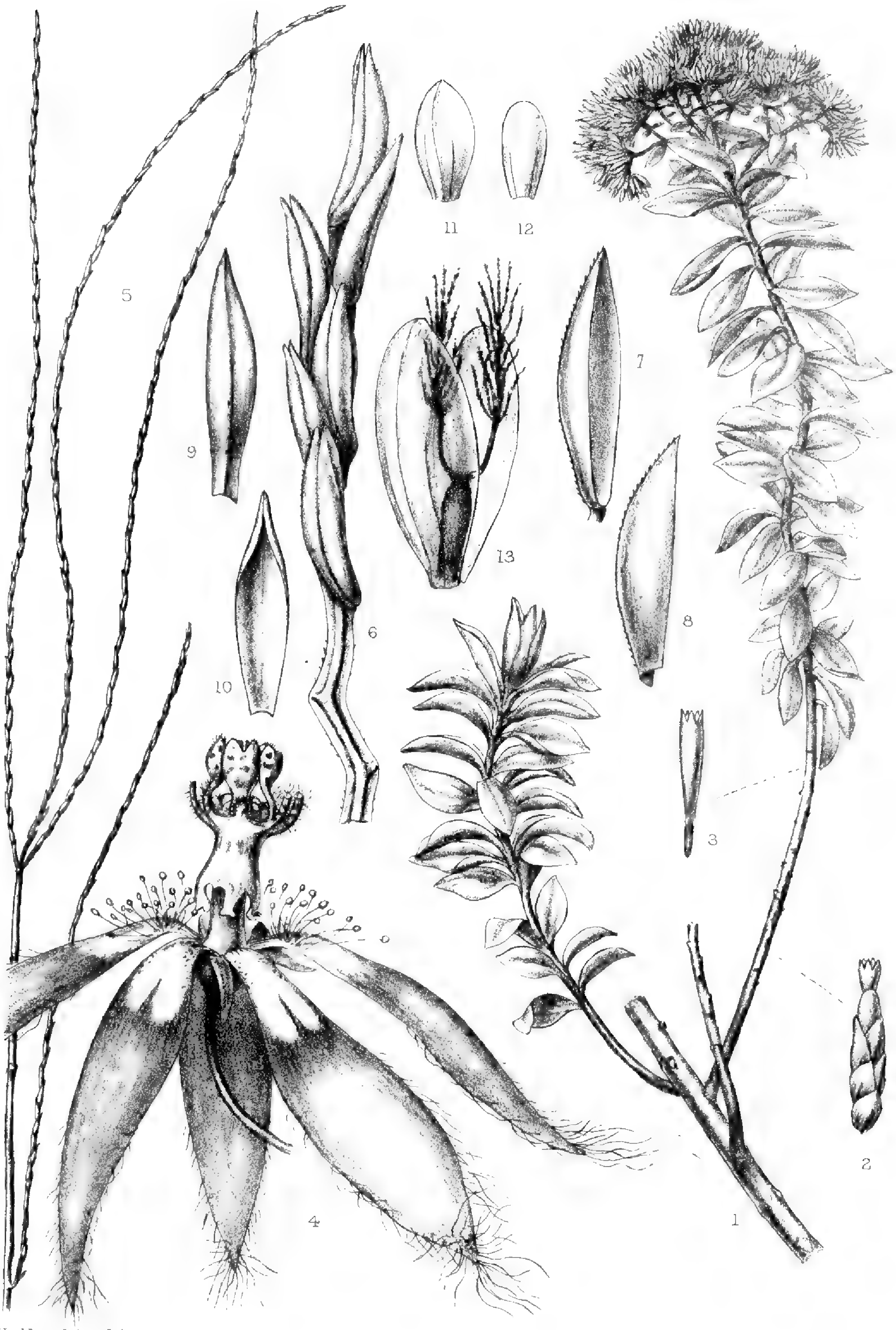
HEINSENIA SYLVESTRIS, *S. Moore*.



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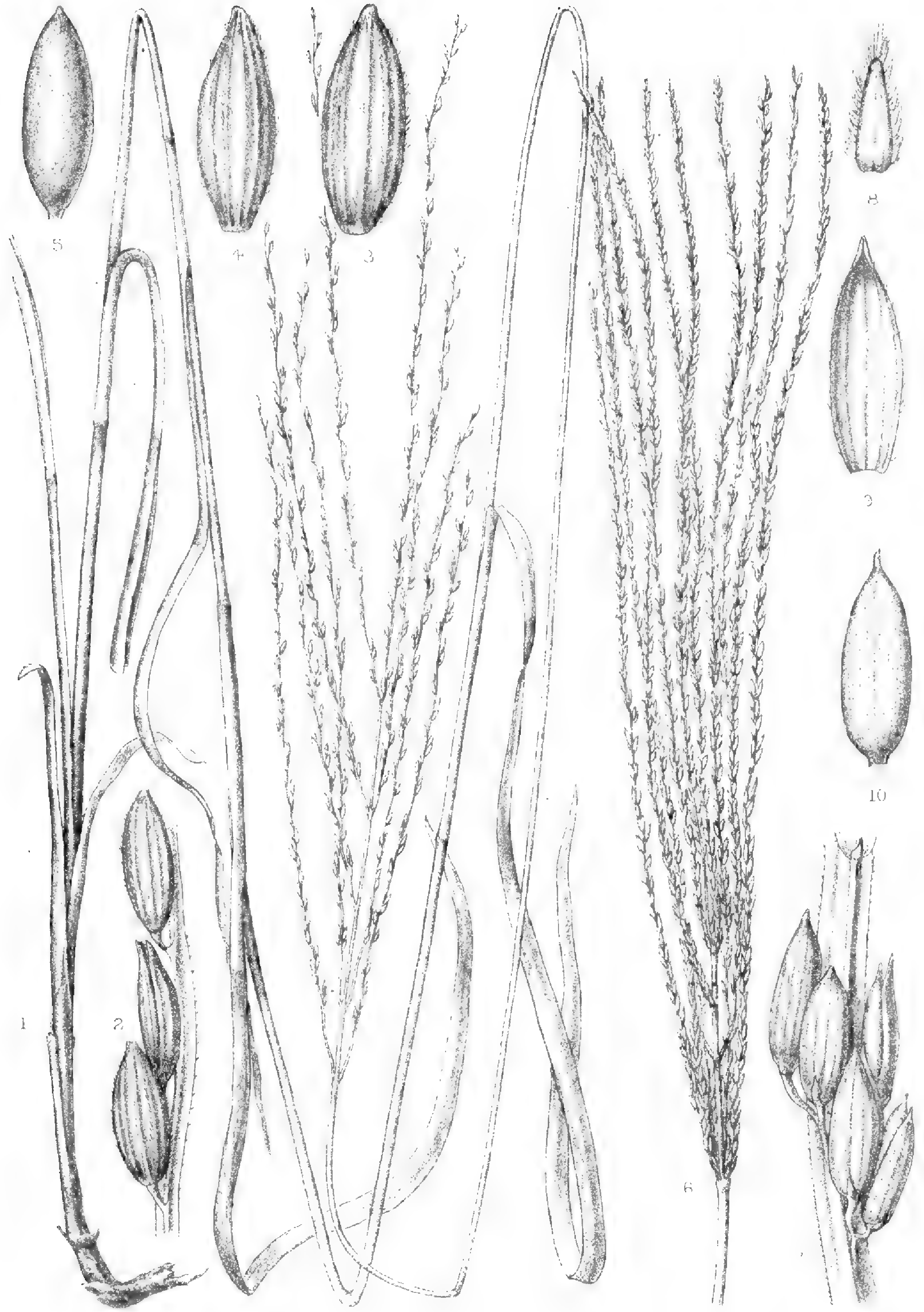
1-3, HUMEA AFRICANA, *S. Moore*. 4, SWYNNERTONIA CARDINEA, *S. Moore*. 5-13, CRASPEDORHACHIS RHODESIANA, *Rendle*.



Highley. del et lith. [illegible]

1–5, DIGITARIA GAZENSIS, *Rendle*.
6–10, [illegible] RTONII, *Rendle*.

MAP OF NORTH-WEST GAZALAND.

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BOTANY

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THE JOURNAL

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On the Comparative Anatomy of the Leaves of Certain Species of *Veronica*.

By R. S. Adamson, M.A., B.Sc. (Edin.), B.A. Emmanuel College, Cambridge. (Communicated by A. G. Tansley, M.A., F.L.S.)

(With 17 Text-figures.)

[Read December 1st, 1910.]

This paper is the outcome of a piece of work undertaken at the suggestion of Professor Weiss, of the University of Manchester, to whom I desire to express my thanks both for suggestions made during the course of the investigation and for material which he obtained for me. I am indebted also to Professor Bayley Balfour for his kindness in supplying me, from the Royal Botanic Gardens, Edinburgh, with the bulk of the fresh material used, and with herbarium material of plants grown in their native habitats.

The genus *Veronica* comprises about 200 species, growing in North Temperate Regions and in the New Zealand Region. Very few occur in the Tropics and few occur in both the North and South Hemispheres. The species found in the Northern Hemisphere are mainly herbaceous, while those of New Zealand are almost entirely shrubs.

Huchedé † has recently studied the anatomy of a large number of species, both herbaceous and shrubby. The present account deals entirely with species, 39 in number, of the shrubby type and natives of New Zealand.

The material used was grown in Britain, but has been compared in as many cases as possible with native plants from herbaria. These are marked with an asterisk (*) in the following lists. For convenience of description the species examined can be divided into five groups founded on external and some structural characters :—

Group A.

The species in this group have large or elongated leaves without very prominent xerophilous adaptations. In this group are the following species :— * *V. salicifolia*, Forst., *V. Cookiana*, Cheesem., * *V. elliptica*, Forst., *V. Lewisii*, Armst., * *V. parviflora*, Vahl, *V. parvifolia*, Vahl. These species all occur in low-lying districts of less than 2000 ft. altitude. *V. elliptica* and *V. Lewisii* are especially found near the sea-coasts ‡ §.

Group B.

The species are externally like those of Group A, but the leaves are thick and leathery and much more xerophilous. In this group are *V. rakaiensis*, Armst., *V. ignota*, Hort. Edin., *V. Pseudotraversi*, Hort. Edin., which are species of mountainous regions.

† Huchedé (1907). ‡ Cheeseman (1906). § Diels (1897).

GROUP C.

This group of species is characterized by small spoon-shaped leaves, which are sessile, somewhat thick, and xerophilous. Included here are *V. linifolia*, Hook. f., *V.* sp. (? *Balfouriana*), **V. Traversii*, Hook. f., **V. vernicosa*, Hook. f., *V. anomala*, Armst., *V. pimeleoides*, Hook. f. These are species of upland and subalpine regions, but are not truly alpine plants.

GROUP D.

The species of this group are extremely like those of the previous group, but the leaves are much more leathery in texture and very often glaucous. *V. Godefroyana*, Carr., *V. pinguifolia*, Hook. f., **V. buxifolia*, Benth., *V. Menziesii*, Benth., **V. Colensoi*, Hook. f., **V. glaucophylla*, Cock., **V. carnosula*, Hook. f., *V. amplexicaulis*, Armst., **V. subalpina*, Cock., *V. monticola*, Armst. These are all plants of alpine and subalpine regions, ascending to 4000–5000 feet and except in a few cases not occurring below 2000 feet.

GROUP E.

These species have very much reduced leaves, which are either small and spreading or appressed and imbricate :— *V. loganioides*, Armst., **V. epacridea*, Hook. f., *V. lycopodioides*, Hook. f., **V. tetrasticha*, Hook. f., *V. Hectori*, Hook. f., **V. Armstrongii*, T. Kirk, *V. propinqua*, Cheesem., **V. cupressoides*, Hook. f. With the exception of the last named these are all alpine species, growing on screes and rocky mountain-slopes. *V. cupressoides* occurs in alpine meadows.

These groups A–E show a series of increasing xerophily. Groups A and B are very closely alike, as also are C and D. Each group shows a greater degree of xerophilous adaptation than the preceding one.

GROUP F.

The species in this group differ from all the others in having leaves with toothed margins and elongated petioles. This group can be separated into two divisions :—(1) upright shrubs : **V. Hulkeana*, F. Muell., **V. Lavaudiana*, Cheesem., *V. Fairfieldi*, T. Kirk ; (2) stem more or less prostrate with ascending annual shoots : *V. catarractæ*, Forst., **V. Lyallii*, Hook. f., and *V. Bidwillii*, Hook. f. These species belong to the lowland region, though they ascend to a considerable height along rivers. *V. Hulkeana* and *V. Lavaudiana* are characteristic of rocky situations in low-lying districts.

General Anatomical Characteristics.

In recent years considerable attention has been paid to the anatomical study of flowering plants from a taxonomic point of view ; it has, for example,

been shown that certain features are constant through whole genera or even orders : among these are the form of hairs and of secretions and the stomatal apparatus *. Several anatomical features of this kind have been noticed in the species examined.

Epidermal Cells.—A feature of the epidermis may be mentioned in this connexion; in all the species examined the lateral walls of the epidermal cells are rectilinear or very slightly curved, not sinuous. They may be very thick and pitted. These features are not common to the whole genus, as the herbaceous forms have the epidermal cells with sinuous walls on the lower side of the leaf †.

Hairs.—As in all Scrophulariaceæ the hairs are uniseriate ‡. Two main types of hairs occur, glandular and eglandular; the former are of two kinds, short-stalked and long-stalked, the first kind being much commoner. In the short-stalked hairs the stalk consists of one or two cells surmounted by an oblong glandular head divided into two by a vertical wall †‡§. This form of hair is typically abundant in the region of the axillary end, where it probably helps to retain and absorb moisture. Long-stalked glandular hairs occur in very few species † ; the stalk consists of a row of 4–6 thin-walled cells, with a small spherical undivided head. The eglandular hairs are never branched; they are of varying form, either unicellular or consisting of a row of 2–6 cells. The walls of the cells are very much thickened in some cases and may be serrated externally in some cases †.

In none of the species examined are hairs very numerous, but, with the exception of *V. subalpina,* all possess some hairs on the leaf. In many cases hairs are confined to the region of the axillary bud.

Secretion.—As recorded by Solereder ‡, the only form of internal secretion is tannin, a feature characteristic of the whole order. Tannin-sacs occur either singly or in groups in the mesophyll of all the species examined, though Huchedé † mentions a complete absence of secretory organs.

Stomata.—In surface view the stomata, in common with the rest of the order, are surrounded by three or more epidermal cells ‡. In most cases the stomata occur on both sides, either in more or less equal numbers or in greater number below, but sometimes they are confined to the lower side. In no case are stomata confined to the upper side.

Hydathodes.—Though not common to all the species, these may be mentioned here. The hydathodes in most cases where they occur are of the simple kind. At the tip of the leaf the vascular bundle ends in a mass of small-celled parenchyma. The epidermis in this region has much thickened walls with cuticle ;

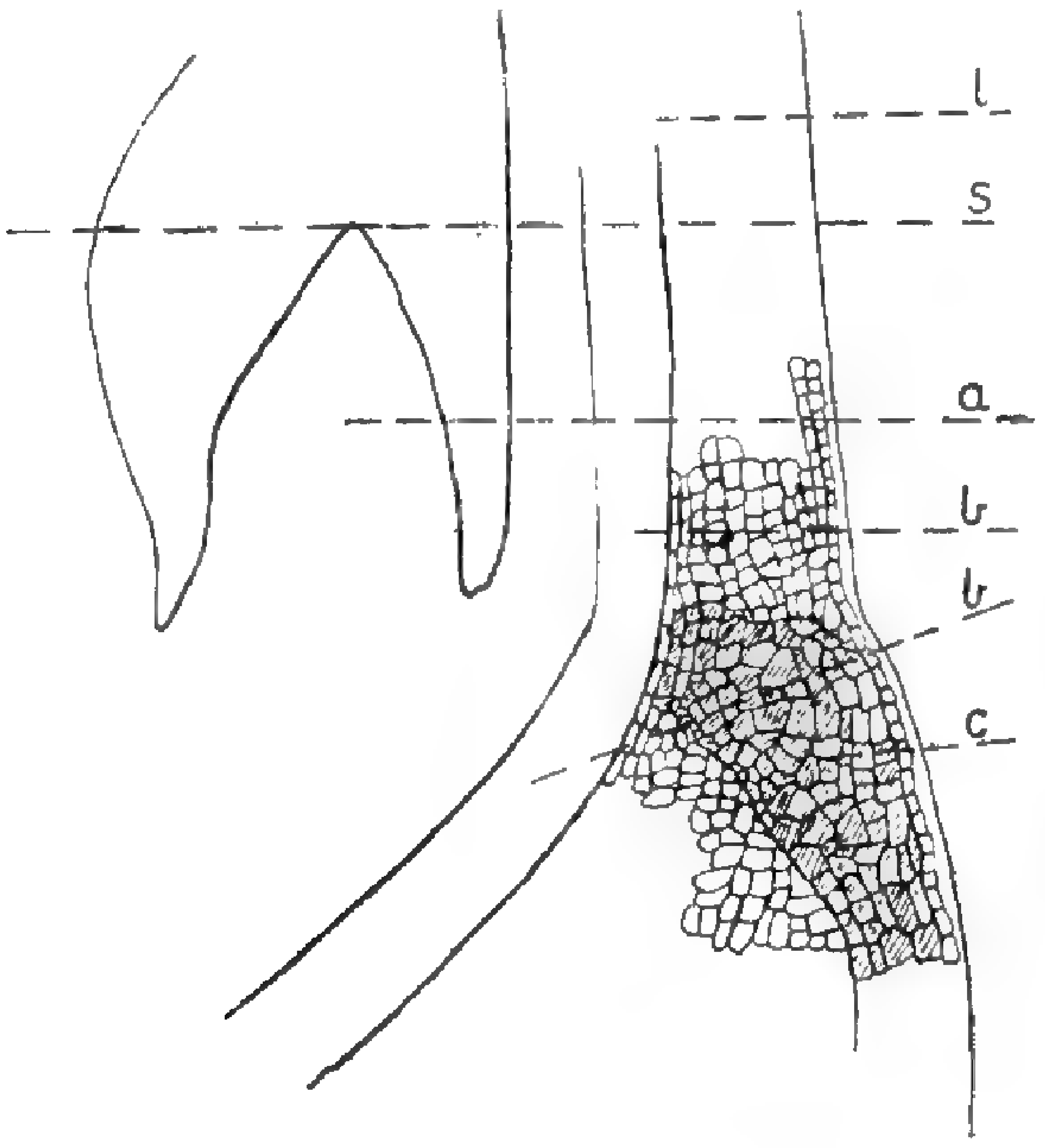
* *Cf.* Fritsch (1903). † Huchedé (1907). ‡ Solereder (1908). § Vesque (1885).

just over the tip of the leaf is a water-stoma. A moderately large intercellular space occurs between the water-discharging parenchyma and the stoma.

Anatomical Features of the Leaf-base.—All the species examined have certain features in common. The phyllotaxis is opposite and decussate. With the exception of Group F, all have almost sessile leaves, with only a constricted portion, or vagina, clasping the axillary bud; this vagina is $\frac{1}{8}$–$\frac{1}{4}$ inch in length. With few exceptions, a single leaf-trace bundle enters the stem from each leaf and passes vertically down through two internodes below the point of insertion, as described by De Bary in *V. incisa* *. Followed upwards the leaf-trace bundle on leaving the stem at once divides in most species, giving off a branch to each side; but in *V. Bidwillii*, which has a short petiole, the trace does not divide till it enters the lamina. The central bundle and the first two branches are prominent throughout the length of the leaf.

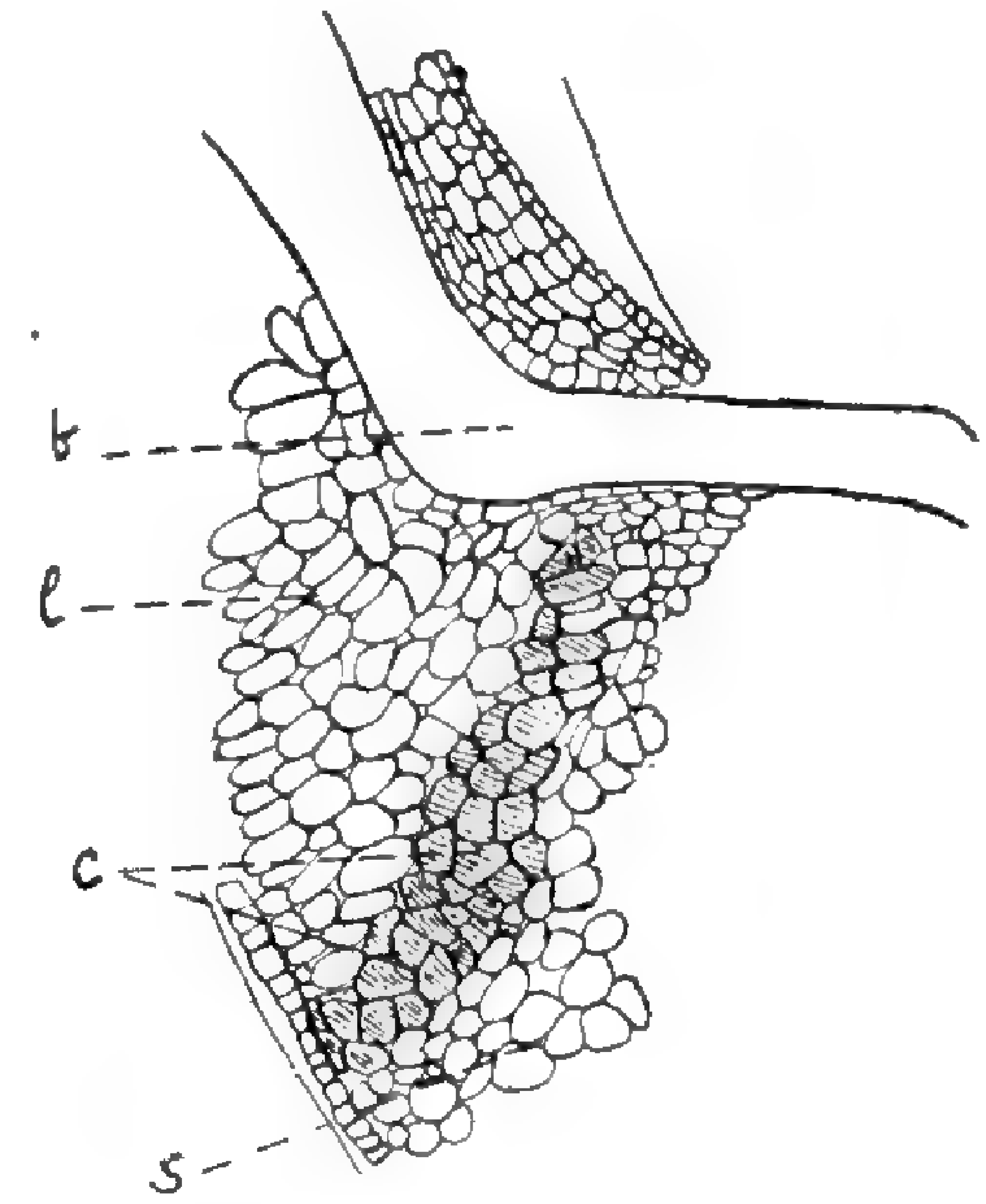
In nearly all the species examined a patch of corky cells is developed at the point of insertion of the leaf (figs. 1 & 2). The number and exact position of

FIG. 1.



Longitudinal section through leaf-insertion of *V. pinguifolia*: axillary bud (*a*); bundle of leaf (*b*); cork-cells (*c*), those of the leaf-base are continuous with the periderm; stem (*s*); and leaf (*l*).

FIG. 2.



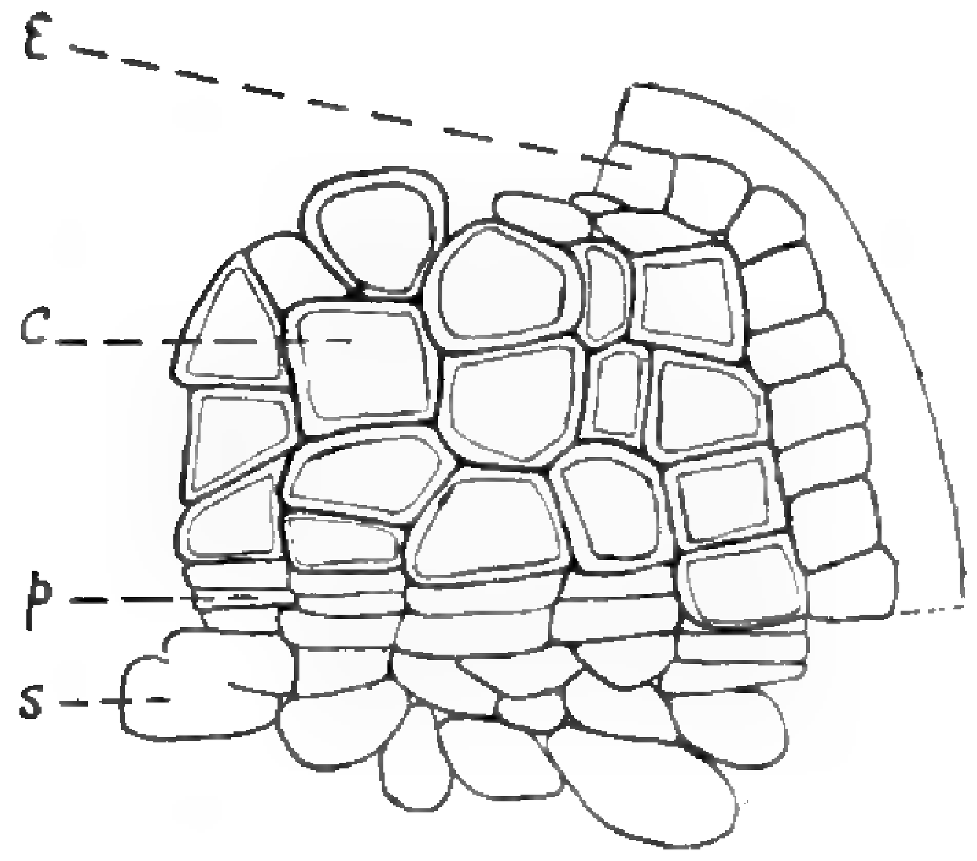
Longitudinal section through the insertion of a leaf of *V. Hectori*: leaf-trace bundles (*b*); leaf-tissue (*l*); cork (shaded, *c*); cortex of stem (*s*). × 115.

these cells varies in different cases. In radial longitudinal section the patch usually appears somewhat triangular, with the apex towards the vascular

* De Bary (1884).

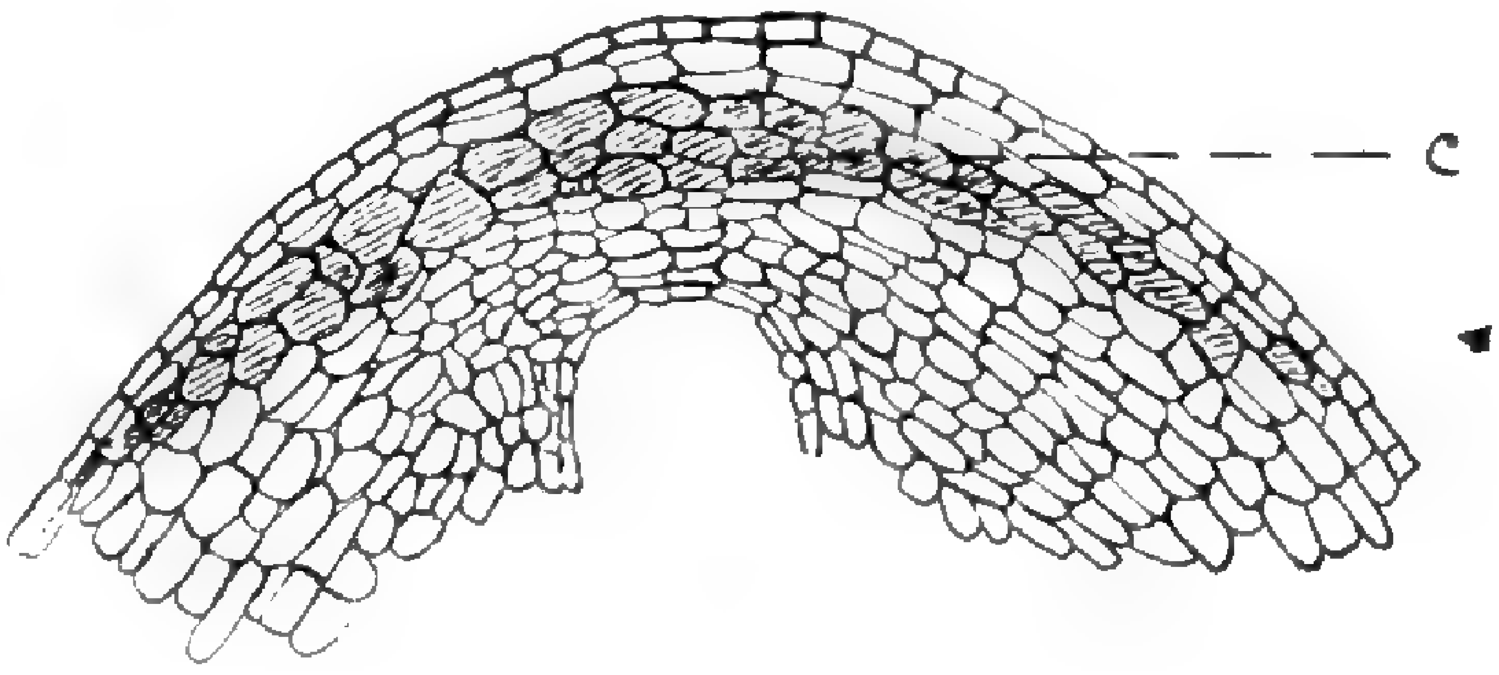
bundle. But in some cases (fig. 2) the tissue is much less in quantity and appears as an inclined plane. In transverse section the appearance is that of a horseshoe-shaped patch in the cortex (fig. 4). This tissue arises by the activity of a phellogen layer that appears in this region. The divisions of the phellogen cut off cork-cells above, so that the development is basipetal (fig. 3). The phellogen ceases to divide after a short period. The time of the first

Fig. 3.



Longitudinal radial section of part of leaf-base of *V. carnosula*, showing phellogen (*p*), cork-cells (*c*), epidermis (*e*), and cortex of stem (*s*).

Fig. 4.



Transverse section at node of *V. Coleniso*, showing position of cork-cells (*c*). × 50.

appearance of this tissue varies, but in most cases, when cork is developed at all, it is during the first year, while the leaf itself persists for two to three years. In many cases this tissue is not represented till periderm formation starts under the epidermis of the stem. In such cases the phellogen forming the cork of the leaf-base is continuous with that of the stem. In other cases, however, the appearance is much earlier, an extreme case being *V. subalpina*, where the tissue can be recognized in the 6th to the 8th pair of leaves counting from the apex.

This arrangement of corky cells at the leaf-base stands in opposition to the view that the translocation of carbohydrate material is carried on in the cortical regions of the petiole as suggested by Haberlandt * and Schimper †. The cortex being completely cut off by these cells, translocation can only go on in the bundle. A condition similar to that existing at the leaf-base in *Veronica* has been described by Strasburger ‡ in *Æsculus Hippocastanum*, where a similar cork-layer is formed across the leaf-base some months before the leaf-fall. In *Veronica* it is found a year or more before the fall.

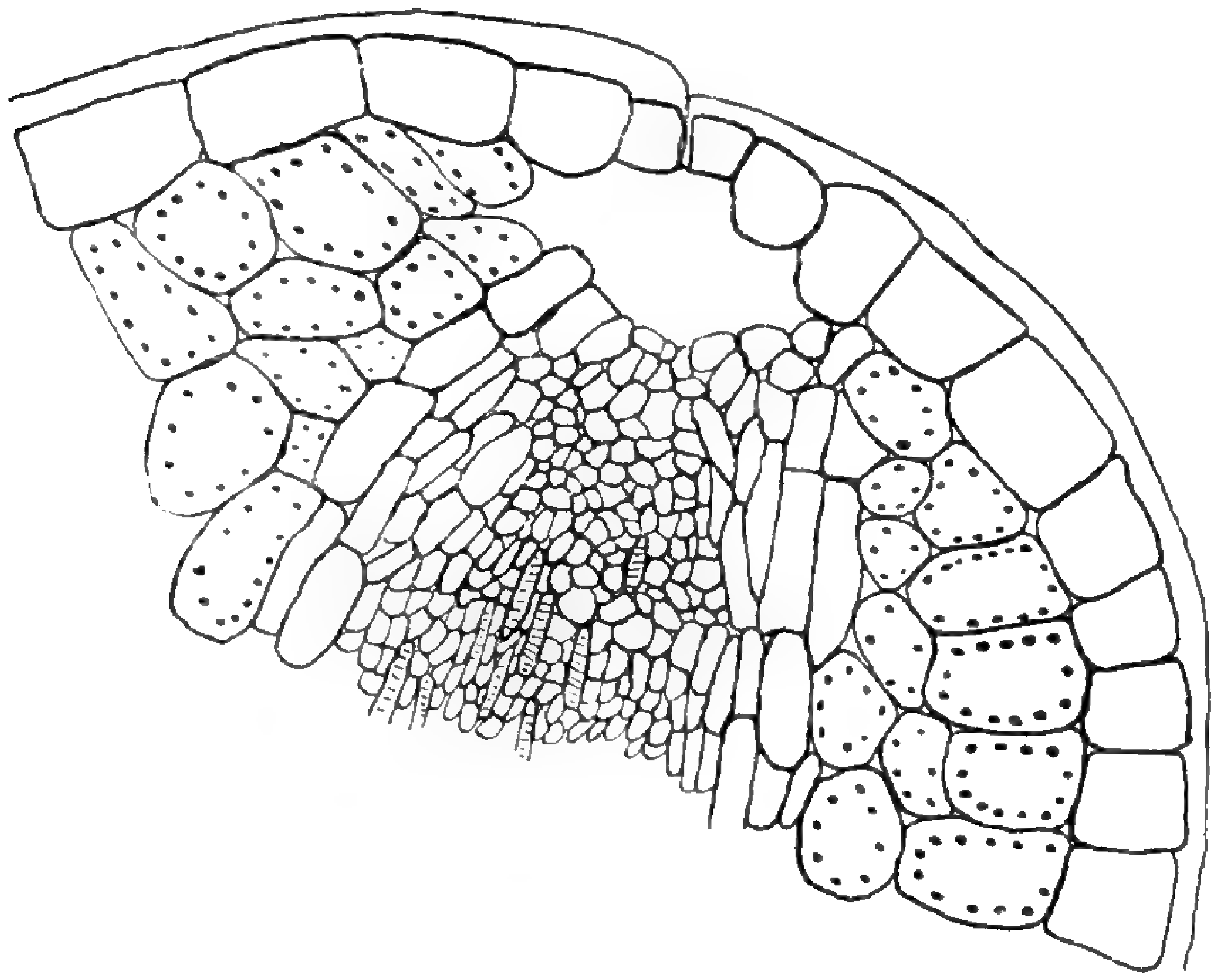
* Haberlandt (1882 & 1909). † Schimper (1885). ‡ Strasburger (1891, p. 487).

Details of the Leaf-anatomy of the Species.

GROUP A.

The leaves are large and elongated. A constant feature in this group is that the central bundle ends in a hydathode; at the tip of the leaf the vascular bundle ends in a mass of small-celled parenchyma beneath a water-stoma (fig. 5). The size of the intercellular space behind the pore varies in different cases.

FIG. 5.



Longitudinal median section of leaf-tip of *V. catarractæ*, showing the termination of the bundle in a hydathode. × 300.

V. salicifolia, Forst.

Leaves sessile, lanceolate-acuminate, 3 × 1 inches, with slightly notched margins.

Along the upper side of the margin and above and below the midrib are rows of stiff cuticularized hairs, each consisting of 2–3 cells. Stomata occur on both sides, numerous below but few above. Those of the upper side have a characteristic structure in section; the guard-cells are small and the adjacent epidermal cells are "scooped out" so that the guard-cell rests on them; the guard-cells have small cuticular expansions.

The mesophyll shows the usual differentiation into palisade and spongy tissues; the latter consists of small rounded cells with small intercellular spaces between; between the palisade and the upper epidermis is a single

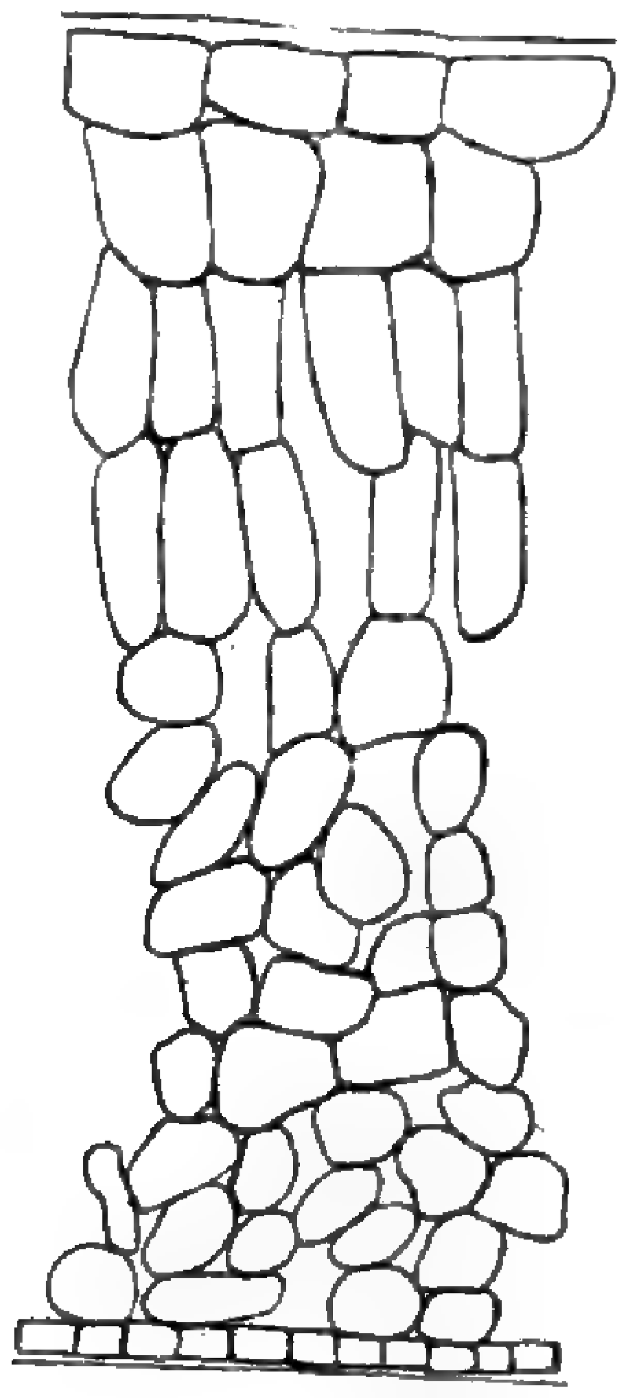
layer of square cells (fig. 6). The central bundle is large, horseshoe-shaped near the base; it ends in a hydathode. It is transcurrent, being connected to the upper and lower epidermis by thickened cells.

This species has been compared with native material from herbaria. The latter agrees in all respects with material grown in Edinburgh, except that the epidermal walls are thicker in the native material.

V. Cookiana, Cheesem.

Leaves large, broad-oval, amplexicaul, $2\frac{1}{2} \times 1\frac{1}{2}$ inches. Round the margins of the leaves is a row of very stiff hairs. The cuticle is thinner than in

Fig. 6.



Section of leaf of *V. salicifolia*. × 200.

V. salicifolia. The distinction between palisade and spongy tissues is not so sharp; the latter has few interspaces. This may be accounted for by the fact that *V. Cookiana* is characteristic of maritime situations.

V. elliptica, Forst.

The leaves are smaller than in *V. Cookiana*, elliptic, and shortly petioled. Around the margin is a dense fringe of hairs, each curved at the end. At the tip this band of hairs passes over a peculiar knob-like structure in which the bundle ends. Glandular hairs occur on the petiole. Stomata are confined to the lower side. The mesophyll is very like that of *V. salicifolia*; the layer of cells above the palisade-tissue contains very few chloroplasts, and forms a so-called hypoderm *. Huchedé figures † this hypodermal layer as double, but in my material and in herbarium material it is only a single layer

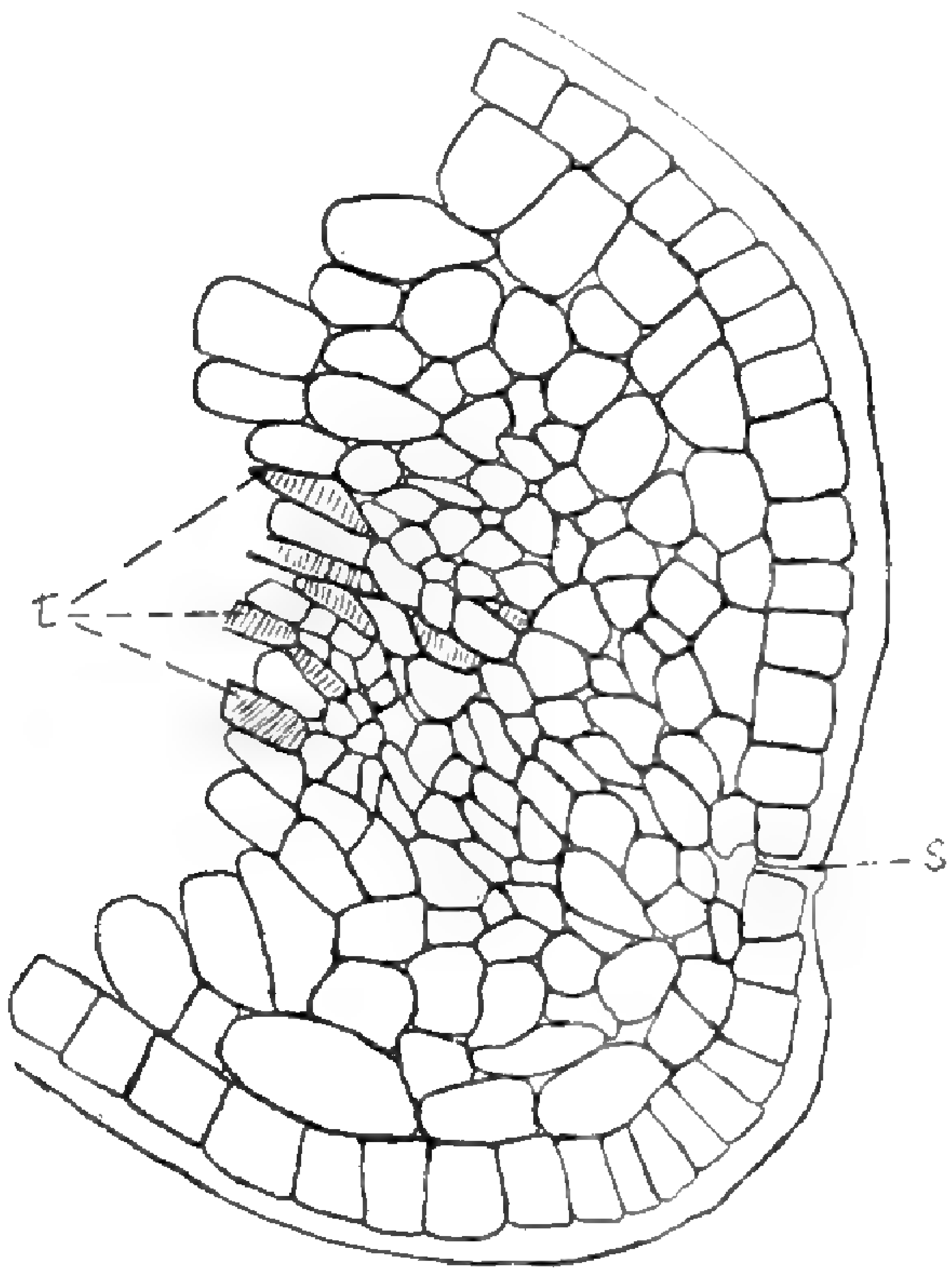
* Huchedé (1907). † *Ibid.* fig. iii.

with occasional cells showing a division. The spongy tissue is formed of many-armed cells with considerable interspaces.

The most striking feature about this species is the knob-like tip to the leaf. In this region the epidermis consists of large columnar cells with thickened and cuticularized outer walls, which pass gradually into the normal epidermis of the leaf. The internal tissue of the knob consists of small-celled parenchyma in which the bundle ends ; the tracheal elements persist till quite near the tip. Opposite the end of the bundle is a small stoma, so that the knob is a peculiarly protected hydathode (fig. 7).

Cork is not developed at the leaf-base till just before the fall of the leaf.

Fig. 7.



Hydathode at leaf-apex of *V. elliptica*: *t* = end tracheids, *s* = water-pore.

V. Lewisii, Armst.

This species is externally very like *V. elliptica*, but the leaves are narrower and larger. A few short hairs occur along the margin. The tip has a quite normal hydathode. Stomata occur on both sides. A hypoderm occurs along the upper side and is sharply marked off from the mesophyll ; it contains no chloroplasts. The differentiation into palisade and spongy tissues is not well marked. Cork is developed in large quantity at the leaf-base.

The next two species, *V. parviflora* and *V. parvifolia*, have very long and narrow leaves.

V. parviflora, Vahl, has leaves 2–3 inches long. Stiff hairs occur over the

midrib, and short-stalked glandular hairs on the under side. *V. parvifolia*, Vahl, is very similar, but has shorter thinner leaves. Structurally these two species are very much alike. Both have stomata on both sides of the leaf: in *V. parviflora* there are few above and a great number below, while in *V. parvifolia* they are numerous on both sides. The mesophyll is differentiated into palisade and spongy tissues, but the latter has very few interspaces. *V. parviflora* has been compared with native-grown herbarium material, and the two leaves agree in all points of structure and arrangement.

The species described above are the least xerophilous of those examined, but even they have certain xerophilous features in the protection of the stomata and the reduction of the intercellular spaces in the mesophyll.

Group B.

The species included in this group are like *V. parviflora*, but have marked xerophilous adaptations; the leaves are thick and have the epidermis much thickened and cuticularized. The central bundle ends in a hydathode.

V. Pseudotraversi, Hort. Edin.

This forms the connecting-link with Group A. The leaves are elongate, concave above, and glabrous except for a few glandular hairs on the lower surface. The stomata are slightly sunk, with cuticular expansions above. The mesophyll shows a slight differentiation, but less than in any of the preceding group.

V. ignota, Hort. Edin.

The leaves are narrow and thick, glabrous except for a few glandular hairs over the midrib. The outer epidermal wall is much thickened and cuticularized with expansions over the stomata. The mesophyll is very homogeneous (fig. 8) and consists of slightly elongated cells, closely packed together; those at the lower side are rather smaller. Tannin is abundant.

V. rakaiensis, Armst.

The leaves are broader and thicker than in *V. ignota*, with a few glandular hairs scattered over the upper surface; structurally the mesophyll shows still less differentiation, it is quite homogeneous, being composed of square cells with few intercellular spaces. Cork is developed early at the leaf-base, whereas in *V. ignota* and *V. Pseudotraversi* it does not appear till later.

Group C.

The species of this group have their leaves small, elliptic-lanceolate, and usually rather concave above. The texture of the leaf is rather leathery.

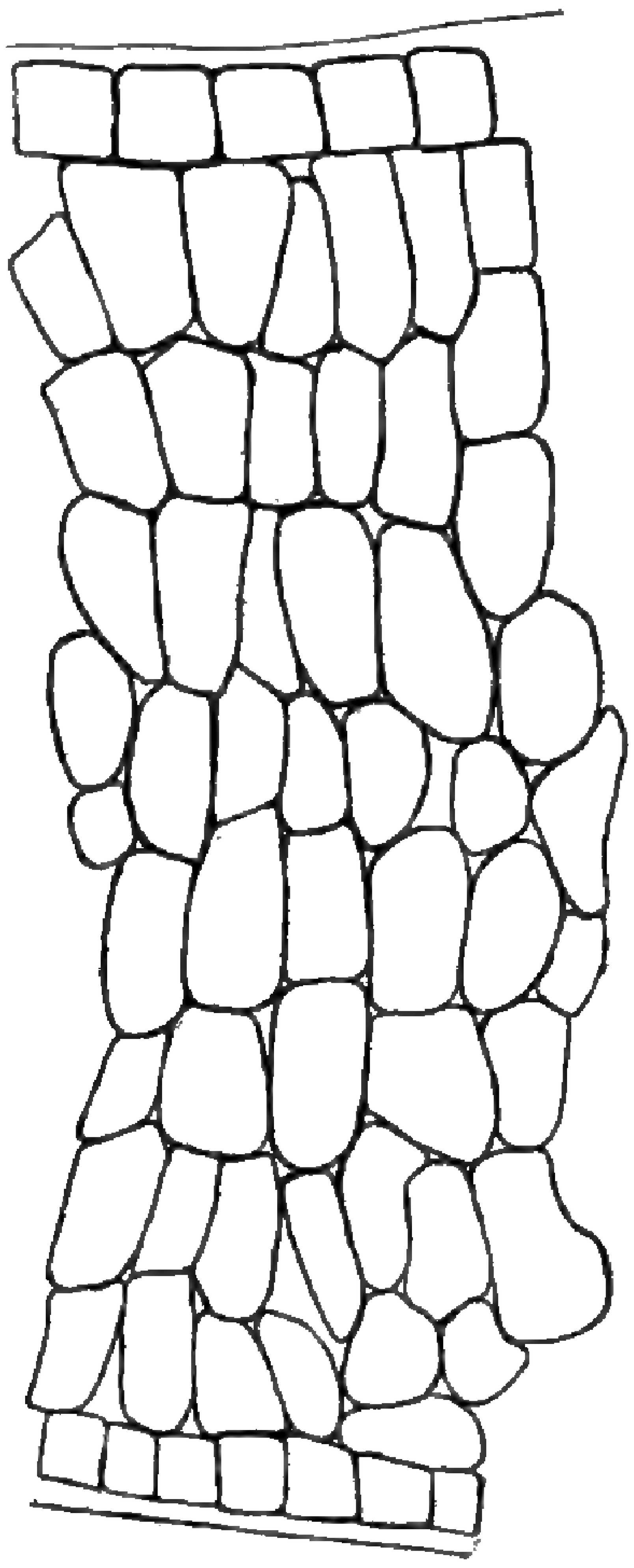
V. linifolia, Hook. f.

Leaves very small, narrow, glabrous and thick. Stomata are more numerous on the upper side. There is a sharp differentiation into palisade and spongy tissues. The small bundles are embedded ; the central one ends in a normal hydathode. Starch is found in large quantities in the mesophyll cells, an exceptional feature among the species examined.

V. vernicosa, Hook. f.

The leaves are small and glabrous, but much larger than in *V. linifolia* The outer walls of the epidermal cells are not much thickened. Stomata

FIG. 8.



Transverse section of leaf of *V. ignota*. × 200.

occur on both sides. There is a regular layer of palisade-tissue that passes gradually into the spongy tissue ; the bundles are transcurrent. The herbarium material agrees in all points with this description.

V. anomala, Armst.*.

This is very like *V. vernicosa*, but smaller in all ways. The cuticularization

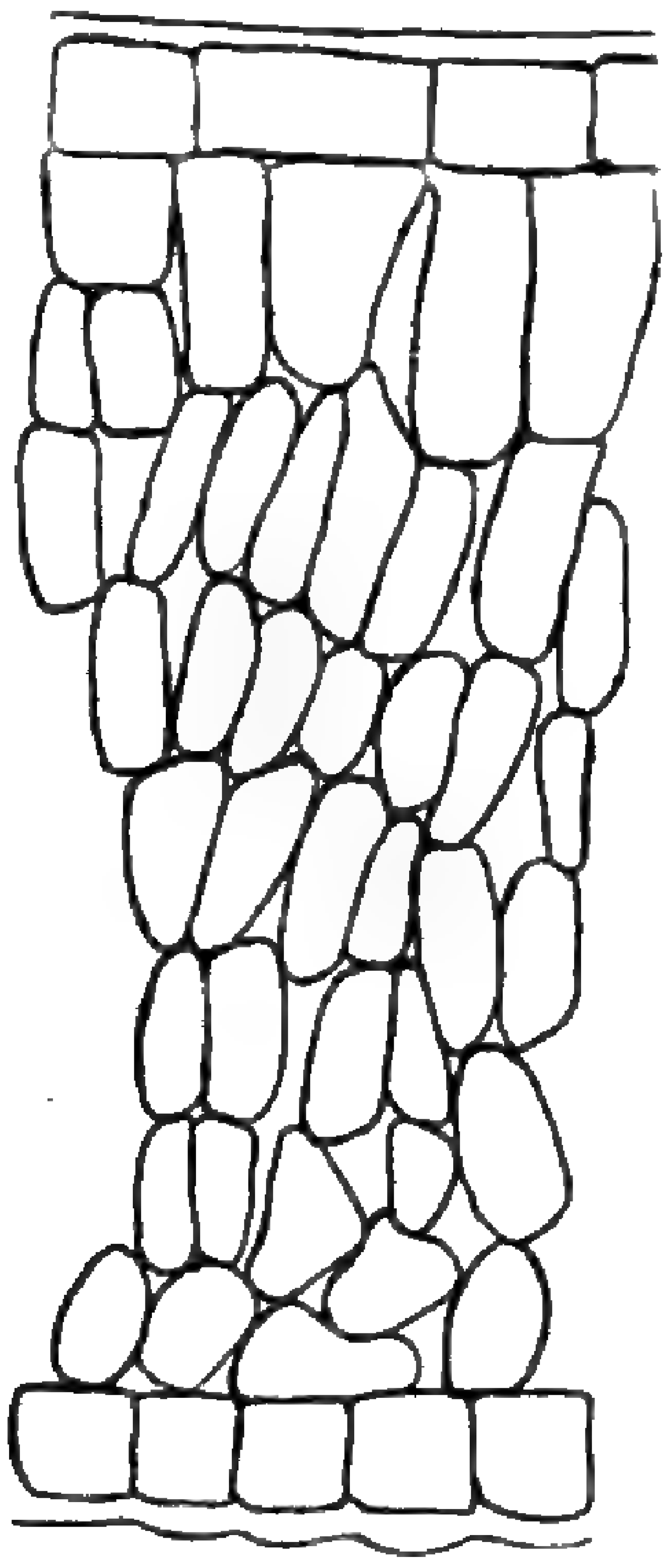
* Bot. Mag. t. 7360.

is thicker, with the stomata on the under side sunk. The spongy cells are elongated, but are separated by larger interspaces than occur between the palisade cells. Both *V. anomala* and *V. vernicosa* have a small hydathode of the normal type at the tip of the leaf, at the ending of the central bundle.

V. Traversii, Hook. f.*.

The leaves are larger, 1 in. by ½ in., the lamina glabrous and slightly concave above. The stomata are much protected (fig. 16 *b*). The greater part of the mesophyll consists of elongated palisade-like cells with only a few rounded ones towards the lower side. The central bundle is vertically transcurrent; the terminal hydathode is very small. Huchedé † describes and

FIG. 9.



Tissue of leaf of *V. Traversii.* × 200.

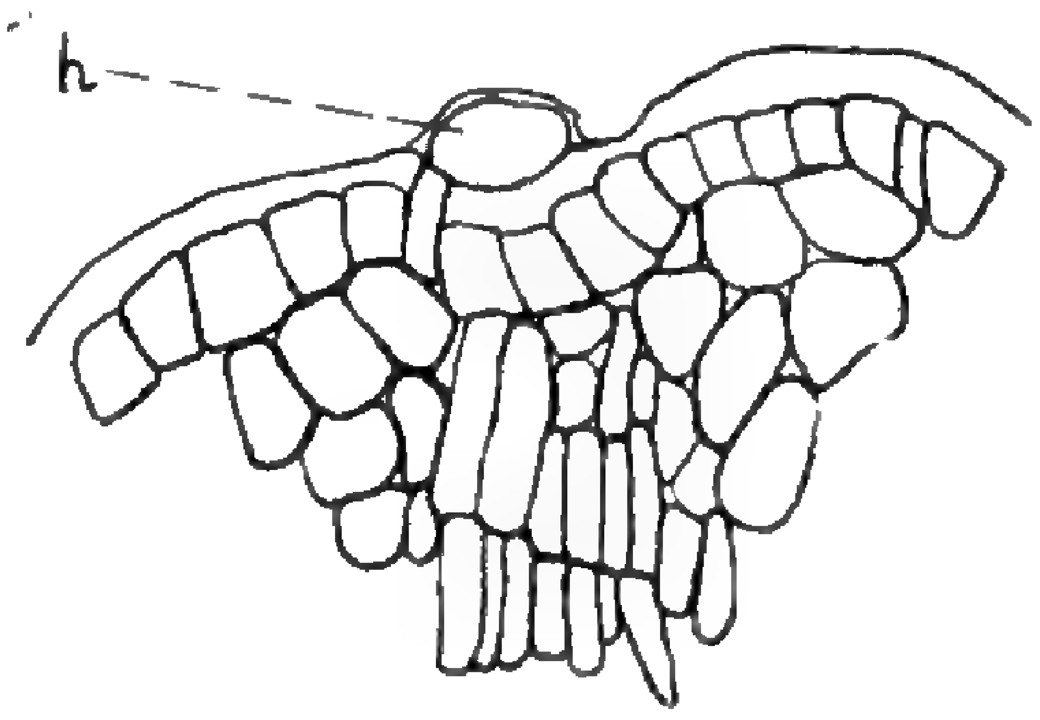
figures a hypodermal layer with rather thick walls along the upper side of the leaf. My material does not show this except in immediate association with the central bundle, and the same is the case with some native-grown material obtained from the Cambridge University Herbarium by the kindness of Dr. C. E. Moss, and also with material collected by Cockayne from the herbarium of the Royal Botanic Gardens, Edinburgh. Leaves from both these sources show the same structure as the fresh cultivated material examined.

* Bot. Mag. t. 6390. † Huchedé, 1907.

V. sp. (? *Balfouriana*, Hook. f.).

This species was cultivated under the name *V. chathamica*, but it is quite different both in form and structure from the plants of that name in Cockayne's herbarium. Externally it is very like *V. Traversii*, but the leaves are slightly larger and not so thick. It seems nearest to *V. Balfouriana* *. Glandular and other hairs occur in the furrow over the midrib. The stomata are not so much protected as in *V. Traversii*. The mesophyll consists of elongated palisade-like cells arranged in vertical rows with considerable interspaces. At the tip is a peculiar form of hydathode termed by Haberlandt a "Köpfchenhydatode" †. At the tip of the leaf a narrow thin-walled cell projects beyond the level of cavities of the epidermal cells, reaching the outer

Fig. 10.



Tissue of leaf-apex of *V.* sp.: under hydathode (*h*). × 180.

surface of the general cuticle in a shallow basin-shaped hollow. Covering this hollow and connecting with the thin-walled cell mentioned is a large cushion-shaped cell which projects above the surface of the leaf. This cushion-shaped cell has protoplasmic content; its outer wall is slightly thickened and cuticularized. This hydathode differs from those described by Haberlandt in having a head consisting of only one cell.

V. pimeleoides, Hook. f.

The leaves are shorter and thicker, concave above. The outer epidermal walls are much thickened and the stomata on both surfaces are sunk. The mesophyll is like that of the preceding species, but with the intercellular spaces much less developed. The midrib is embedded; its bundle does not end in a hydathode. *V. pimeleoides* forms the connecting-link with the next group.

Group D.

Externally the leaves of the species in this group are like those of Group C, but are thicker and much more xerophilous, usually concave above and often

* Bot. Mag. t. 7556. † Haberlandt (1894) (1909).

glaucous. The mesophyll seldom shows a differentiation into palisade and spongy tissues, but is in most cases very homogeneous. The bundles end simply and not in hydathodes. Stomata occur on both surfaces. Except when specially mentioned the bundles are embedded.

V. Godefroyana, Carr.

The leaves are thick, acute, and glaucous, also quite glabrous. In section the layers of mesophyll cells next the upper epidermis are more elongated and have more chloroplasts, but otherwise there is no differentiation.

V. pinguifolia, Hook. f. *.

The leaves are spoon-shaped, obtuse and glabrous. The whole mesophyll consists of slightly elongated cells, which have more chloroplasts towards the upper side.

V. buxifolia, Benth.

This species is like *V. pinguifolia*, but the leaves are softer and broader. The mesophyll is like that of *V. Godefroyana*, but is more completely palisade-like. The axillary bud is in a recess formed by the hollowing out of the stem and leaf-base. Native material has the outer walls of the epidermis more thickened than has the material grown in this country.

V. Menziesii, Benth.

The leaves are smaller, $\frac{3}{4} \times \frac{1}{4}$ in. The stomata on both sides are sunk. The mesophyll is very homogeneous, consisting of square or rounded cells with few interspaces, except close to the lower side. The central bundle is transcurrent, being connected to the epidermis above and below by a small patch of thickened cells. Cork does not appear at the leaf-base till periderm formation commences on the stem.

V. Colensoi, Hook. f.

The leaves are smaller than in the preceding species, and glaucous, with the outer thickenings of the epidermis more developed. The mesophyll, both in cultivated and herbarium material, is like that of *V. pinguifolia*. Cork appears early at the leaf-base.

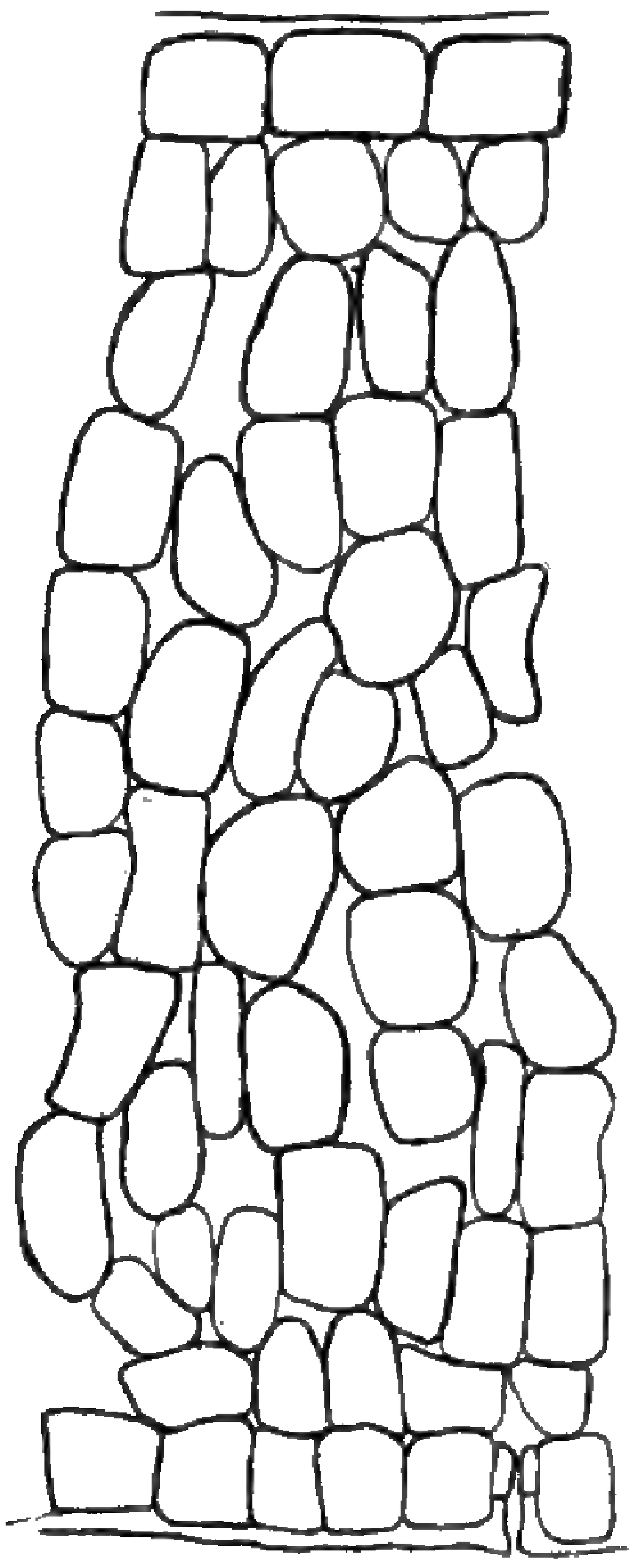
V. glaucophylla, Cock.

The leaves are larger and very glaucous ; the outer walls of the epidermal cells are much thickened and cuticularized. Stomata occur in greater numbers on the upper side. The mesophyll is quite homogeneous (fig. 11)

* Bot. Mag. t. 6147.

Cheeseman * regards this species as identical with *V. Darwiniana*, Col., but Huchedé † figures a distinct hypoderm in that species, which is absent in my material both in the cultivated and in the native material collected by Cockayne; this last shows, however, a strengthening layer beneath the epidermis at the edges of the leaf, which is absent from the cultivated material.

FIG. 11.



Transverse section of leaf of *V. glaucophylla*. × 200.

V. carnosula, Hook. f. ‡.

This species has its leaves very like those of *V. glaucophylla*, but small and not glaucous. The mesophyll shows very little differentiation. The cultivated plants agree in all points with native plants from herbaria.

V. amplexicaulis, Armst. §.

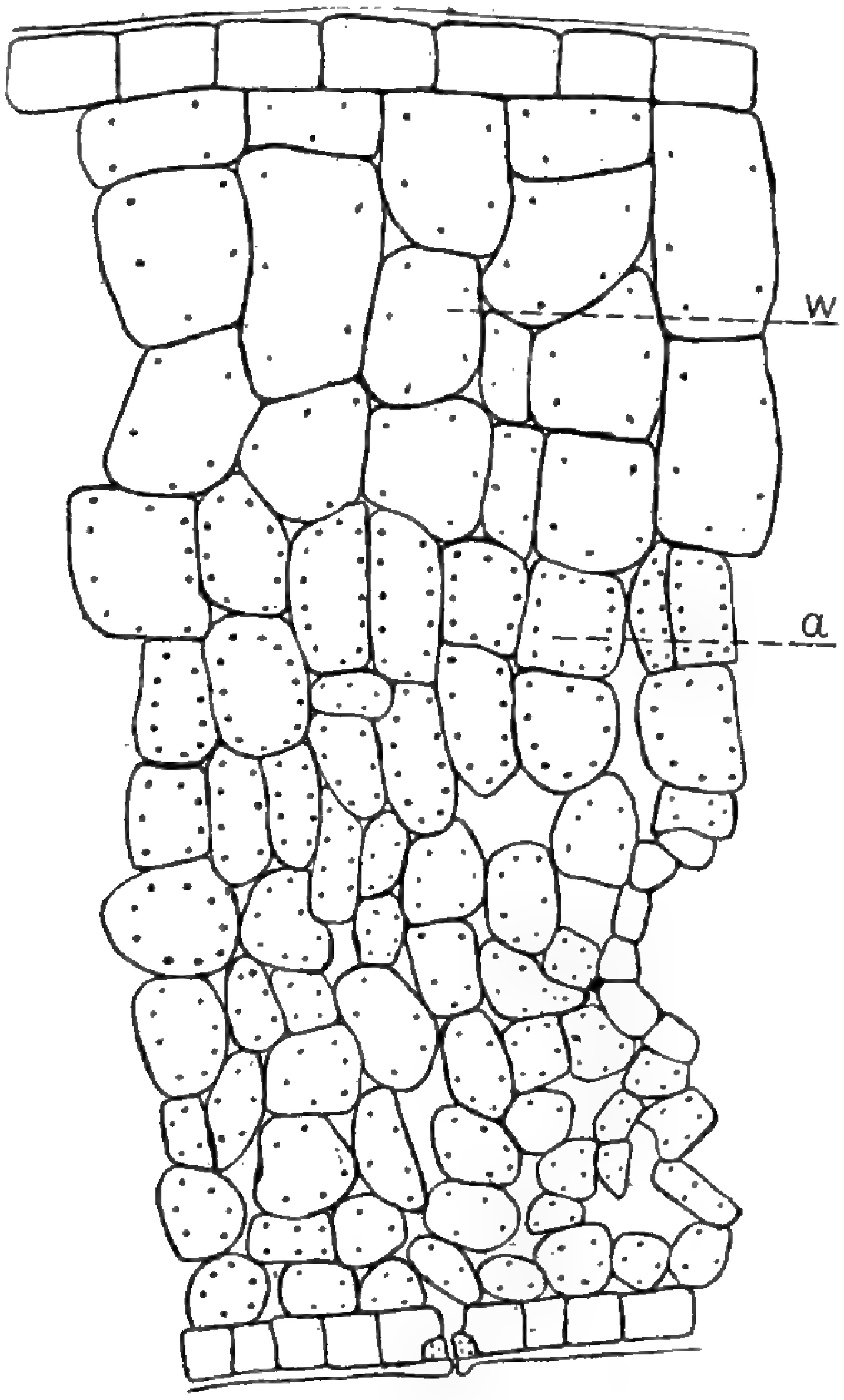
The leaves are thick and glaucous, concave above and somewhat imbricate round the stem. The stomata on the lower side are sunk with considerable cuticular protection; those on the upper side are larger and less protected: this is probably due to the position occupied by the leaves. The whole mesophyll consists of slightly elongated cells.

* Cheeseman (1906). † Huchedé (1907). ‡ Bot. Mag. t. 6587. § Bot. Mag. t. 7370.

V. subalpina, Cock.

The leaves are mostly small, glaucous, and quite glabrous, with much thickened epidermal cells. The mesophyll consists of rounded cells, which are rather smaller towards the lower side. Herbarium material showed a tendency towards a hypoderm formation under the upper epidermis. The cells here have few chloroplasts and much vacuolated protoplasm; this is quite absent in the cultivated material. Cork is developed very early at the leaf-base.

Fig. 12.



Transverse section of leaf of *V. monticola*. *a*=assimilating cells; *w*, hypodermic tissue. × 200.

V. monticola, Armst.

This species shows some marked peculiarities. The leaf is short, lanceolate, and soft in texture; it is furrowed above, with a corresponding keel below. The wings are very thick, owing to several layers of large cells between the upper epidermis and the main assimilating tissue; these large cells contain

few chloroplasts and have much vacuolated contents. They occupy nearly half the thickness of the leaf (fig. 12). They seem to form a kind of water-tissue. Stomata are confined to the lower side. A few hairs occur along the furrow above the vertically transcurrent central bundle.

GROUP E.

In this group are plants with very much reduced leaves. The reduction has resulted in various forms: e. g., *V. lycopodioides* and *V. tetrasticha* have an ericoid appearance, while *V. Hectori* has the leaves completely clasping the stem with no free portion; again, in *V. cupressoides* the leaves are very small and thick, and do not cover the whole internode as they do in the other species of this group. With the exception of *V. tetrasticha*, the xylem elements of the leaf-bundles have very much thickened walls, so that the lumina of the cells are almost obliterated in some cases *.

V. loganioides, Armst. †.

The leaves are reduced, but spreading; they are stiff, with clasping bases. Stomata are more numerous on the upper side. The leaves are rather thick, with several layers of palisade-cells; the spongy tissue consists of closely packed rounded cells. The bundles, as in all the species in this group, are embedded.

V. epacridea, Hook. f.

The leaves are small and appressed when young. Stomata occur in moderate numbers on both sides. The mesophyll is composed of palisade-like cells. The xylem in cultivated material is normal, but in material from Cheeseman's herbarium it shows the great thickening referred to above.

V. lycopodioides, Hook. f. ‡.

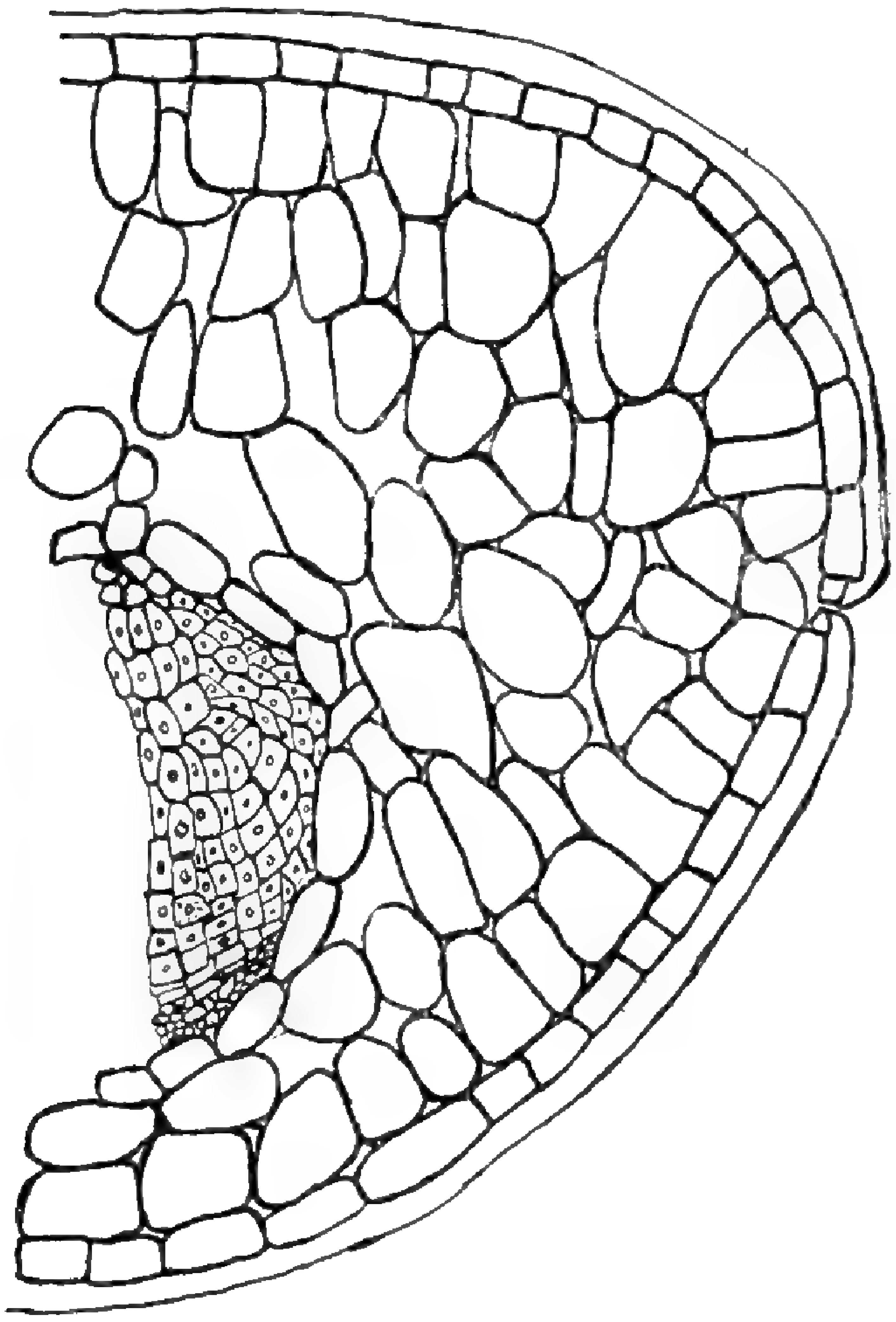
The leaves are stiff and awl-shaped. The epidermis of the upper and outer parts has much thickened cuticularized walls. Stomata are confined to the free point. The mesophyll near the tip is very homogeneous (fig. 13), but in the lower part there is greater differentiation; a layer of water-tissue occurs along the upper (*i. e.* inner) side, and a layer of palisade-cells occurs along the lower side. Cork is developed at the leaf-base.

V. tetrasticha, Hook. f.

Externally the leaves are very like those of *V. lycopodioides*, but are not so stiff and are broader. Stiff bristle-like hairs occur along the margins below. The epidermis of the free parts consists of large cells with their outer walls very much thickened and cuticularized. The mesophyll is like that of *V. lycopodioides*, but the bundles, both in cultivated and herbarium material, are very small, with normal xylem.

* *Cf.* Huchedé (1907). † Bot. Mag. t. 7404. ‡ Bot. Mag. t. 7338.

Fig. 13.



Transverse section of leaf of *V. lycopodioides*, near the tip. × 300.

V. Hectori, Hook. f. *.

The leaves here are completely appressed to the stem ; they are blunt and connate at the base, with a few hairs at the point of junction. The outer epidermis has its outer cuticularized walls as thick as the cell-cavities are deep, so that the guard-cells of the stomata are deeply sunk beneath the surface of the cuticle ; the entrance to the stomatal vestibule is very narrow (fig. 16 *a*). There is a layer of water-tissue along the inner (upper) epidermis ; palisade-cells occur along the outside. The bundles lie close to the inner side. The leaf-trace passes horizontally through the cortex and bends at right angles on entering the leaf (fig. 2, p. 250) ; the dense thickened xylem begins after this point. Cork-cells are developed as a narrow band almost at right angles to the leaf-trace.

V. Armstrongii, T. Kirk.

This is very like *V. Hectori*, but has thinner branches and the tips of the leaves are free. The epidermal walls are less thickened than in the last, but

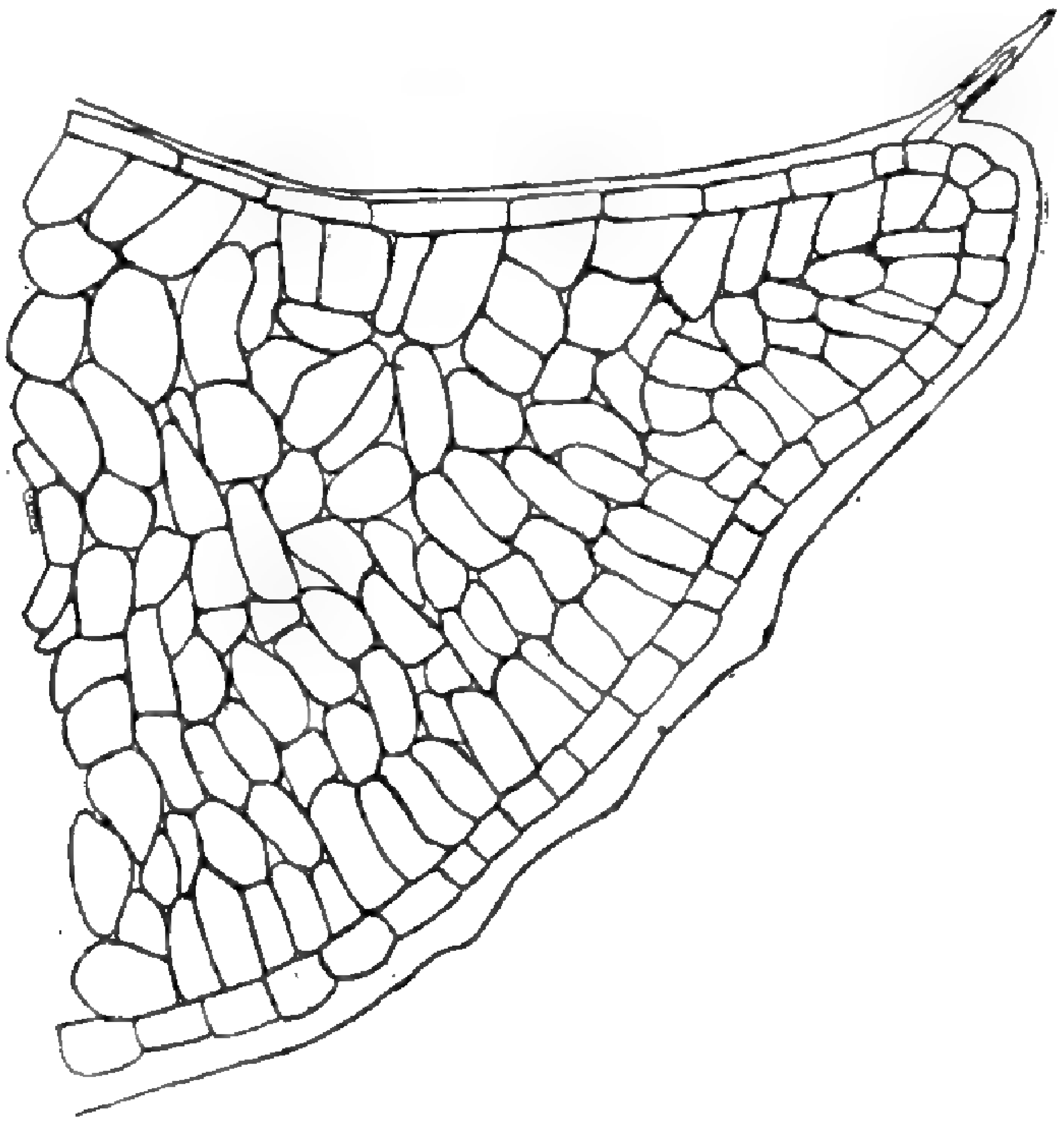
* Bot. Mag. t. 7415.

in native material, not in cultivated, some thickening occurs on the inner appressed part. Stomata occur on both sides at the tip of the leaf. The leaf-trace passes out normally and the leaf-bundles are central in the mesophyll, which in structure is very like that of *V. Hectori*. Cork is only developed at the base of old leaves.

V. cupressoides, Hook. f.*.

The leaves are small and fleshy and slightly spreading, with hairs along their margins. The epidermis is more strengthened on the under side.

FIG. 14.



Transverse section of leaf of *V. cupressoides*. × 200.

Palisade-cells are developed along the lower side (fig. 14)†. Cork is not developed at the leaf-base. Stomata are confined to the lower side of the leaf, but they also occur on the assimilating stem.

V. propinqua, Cheesem. = *V. cupressoides* var. *variabilis* ‡.

This is the plant often cultivated as *V. salicornioides*, but is not the true *V. salicornioides*, Hook. f. It is like the preceding, but has more appressed leaves and shorter internodes. The palisade-tissue is very slightly differentiated from the rest of the mesophyll. Cork occurs at the leaf-base.

* Bot. Mag. t. 7348.
† *Cf.* Goebel (1908), fig. 15.
‡ N. E. Brown (1888).

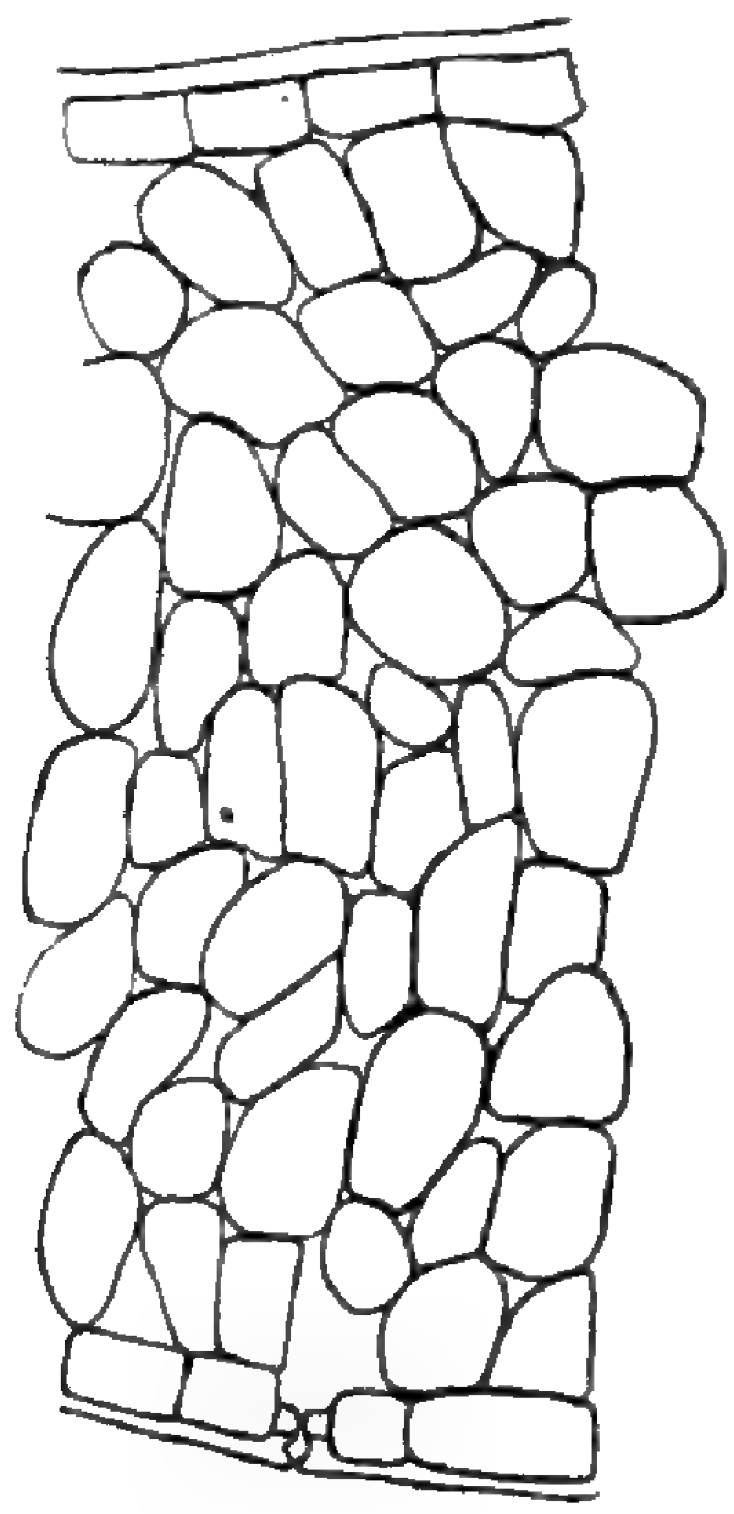
Heterophylly of the Species of Group E.

These highly modified forms of *Veronica* are all heterophyllous *. If they are grown under conditions of greatly increased moisture and diminished illumination they produce spreading leaves †. In the seedling stage also, so far as is known, the leaves are spreading ‡ § ; so that adult forms producing such leaves may be regarded as reversions to a primitive condition. Material of *V. cupressoides* and *V. Armstrongii* was obtained in this state from plants grown in a shady and moist house in the Edinburgh Botanic Gardens.

V cupressoides, Hook. f. ‖.

The leaves are small and petiolate and somewhat pinnatifid, owing to the projection of lateral veins. The epidermis is less thickened than in the type.

Fig. 15.



Transverse section of "reversion" leaf of *V. cupressoides.* × 200.

Stomata occur on both sides. The mesophyll is very like that of *V. Godefroyana* (belonging to Group D), but more homogeneous (fig. 15). The xylem of the bundles is quite normal.

V. Armstrongii.

The leaves have short petioles and toothed laminæ. Stomata occur on both sides, but are more numerous above. The mesophyll is very homogeneous.

* Lindsay (1889).
† Goebel (1908).
‡ Goebel (1900).
§ Cockayne (1900).
‖ Goebel, Pfl. Schild. p. 19 (1889).

Group F.

The species in this group have petiolate leaves with toothed margins; the bundles end in hydathodes, which occur both at the tip of the leaf and also at the tip of each tooth.

V. Hulkeana, F. Muell. *.

The petiole is long; the lamina thick and glabrous. Stomata are confined to the lower side of the leaf. The mesophyll shows the normal differentiation. Next the upper epidermis is a layer of clear vacuolated cells, forming a hypodermal water-tissue †; also along the lower epidermis are 2–3 somewhat irregular layers of cells, distinguished from the spongy tissue by their having clear contents and no chloroplasts. This lower water-tissue is much more marked in herbarium material of native plants than in cultivated leaves. The central and main lateral bundles are transcurrent. The petiole consists of cylindric parenchymatous cells, with the horseshoe-shaped bundle and its two main branches; further branches occur near the top.

V. Lavaudiana, Cheesem. ‡.

The leaves are smaller and hairy, being covered with long- and a few short-stalked glandular hairs on both sides; this character is less marked in herbarium material of native plants. Stomata occur on both sides and no water-tissue is developed.

V. Fairfieldi, T. Kirk §.

This is supposed to be a hybrid between the two preceding species, and has never been found in the wild state ‖. Externally it is very like *V. Hulkeana*, of which Cheeseman regards it as a variety. Short-stalked gland-hairs occur in small numbers on the upper side. Stomata are found on both sides of the leaf. No water-tissue is present.

The next three species differ in their prostrate mode of growth from the preceding and are externally very like one another, differing, as far as the leaves are concerned, mainly in size. In all the bundles are embedded.

V. catarractæ, Forst.

In external characters this is a very variable species. The leaves are stiff and glabrous, with short petioles. Stomata are few in number on the upper as well as on the lower side. The mesophyll, both in cultivated and

* Bot. Mag. t. 5484. † Huchedé (1907). ‡ Bot. Mag. t. 7210.
§ Bot. Mag. t. 7323. ‖ Cheeseman (1906).

herbarium material, shows the normal differentiation, but has few lacunæ in the spongy tissue. There is a layer of cells next the upper epidermis, with few chloroplasts, that appears to be a water-tissue.

V. Lyallii, Hook. f. *.

This is very much smaller than the preceding, but otherwise it is very similar. The spongy tissue, especially in herbarium material, has a considerable lacunar system. The epidermis is considerably thickened round the terminal hydathode.

V. Bidwillii, Hook.

This is very like *V. Lyallii*, but has smaller leaves and shorter petioles. Glandular hairs occur on the lower side. The petiole throughout its length has a single bundle ; cork is present at its base.

General Conclusions.

Climate.

In New Zealand there are two very different types of climate † ‡. In the North Island and the western side of the South Island the climate is moist and warm, and such vegetation as Temperate Rain Forest ‡ is developed. On the other hand, in the whole of the South Island east of the main chain of the Southern Alps the conditions are quite different ; the rainfall is much less and the average summer temperature low, with frequent dry winds. The following table is taken from Diels †:—

	West Side.				East Side.		
Province	Auckland, N. I.	Taraniki, N. I.	Wellington, N. I.	Nelson, S. I.	Dunedin, S. I.	Christchurch, S. I.	Invercargill, S. I.
Rainfall, cm.	106	149	125	154	89	64	117
,, % winter	61	52	51	27	51	36	47
,, % summer	33	35	37	22	58	28	40
Average Temp., ° C.	15	12	13	13	10	12	10
Diff. warmest and coldest months	8·9	8·7	8·2	9·5	8·5	10·4	9·4

The result is a quite different type of vegetation on the east side. Forests are not extensive, and instead "elfin-wood" and steppe conditions are developed ; the montane type of vegetation also comes down to much lower levels in this part ‡. The plants have become thoroughly adapted to these

* Bot. Mag. t. 6450. † Diels (1897). ‡ Schimper (1903).

conditions and are not now very plastic, as is seen from the very slight structural differences between native-grown and cultivated plants of the same species.

Distribution of Veronica *.

Of all the species of *Veronica* found in New Zealand, only about three occur elsewhere. The others are all endemic †. Of these also more than two-thirds are confined to the South Island and to the eastern side of it †. Of the species examined, those that occur in other parts are either the less xerophilous species, *V. salicifolia*, *V. Cookiana*, or montane species, which in the North Island grow near the summit of mountains, especially in the Hawkes Bay District.

Veronicas do not occur in the forest-regions of the west, with the exception of the coastal species *, but are abundant in the "elfin-wood" and upper regions of the east.

Correlated with these conditions is the more or less xerophilous structure of all the species examined—a feature common to many plants of the east side of the South Island ‡. Most of the species with spreading leaves come under Hansgirg's *Myrtus* type of leaf, and the others in his *Erica* type §.

The xerophily is arrived at in various ways: the most obvious being those features mentioned above—reduction of leaf-surface, of the intercellular space system, and the cuticularization of the epidermis. Some special features may be mentioned :—

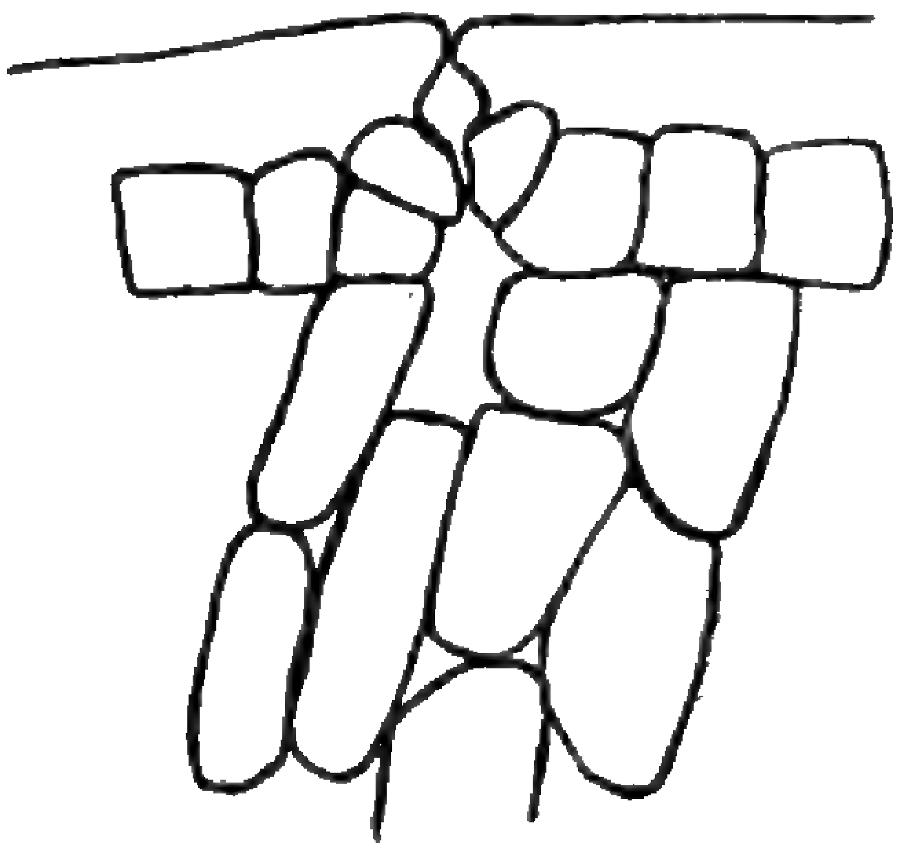
Stomata.—Stomata vary greatly in size and distribution through the different species. In most cases they occur irregularly scattered over both sides of the leaf; sometimes they are absent from the upper side, but none of the species showed a complete absence from the under side. In number there is great variation: in Group A stomata are numerous below and scarce above—e. g., *V. Cookiana* has about 2200 per sq. mm. below and only a tenth of that number above; in the more xerophilous forms the numbers (about 250–400 per sq. mm.) are approximately evenly distributed on the two sides. In six species stomata are absent from the upper side: *V. Hectori*, *V. cupressoides*, and *V. propinqua* have the upper surfaces closely pressed against the stem; and of the others, *V. Hulkeana* and *V. elliptica* have one or more layers of hypoderm along the upper side.

A noticeable feature, especially in the more xerophilous forms, is the presence of curved expansions of cuticularized wall over the stomatal aperture ‖. In the simplest cases these take the form of a slight thickening over the guard-cells; more often, however, the wall in this region projects

* Engler (1882).
† Cheeseman (1906)
‡ Herriott (1905).
§ Hansgirg (1903).
‖ Diels (1897).

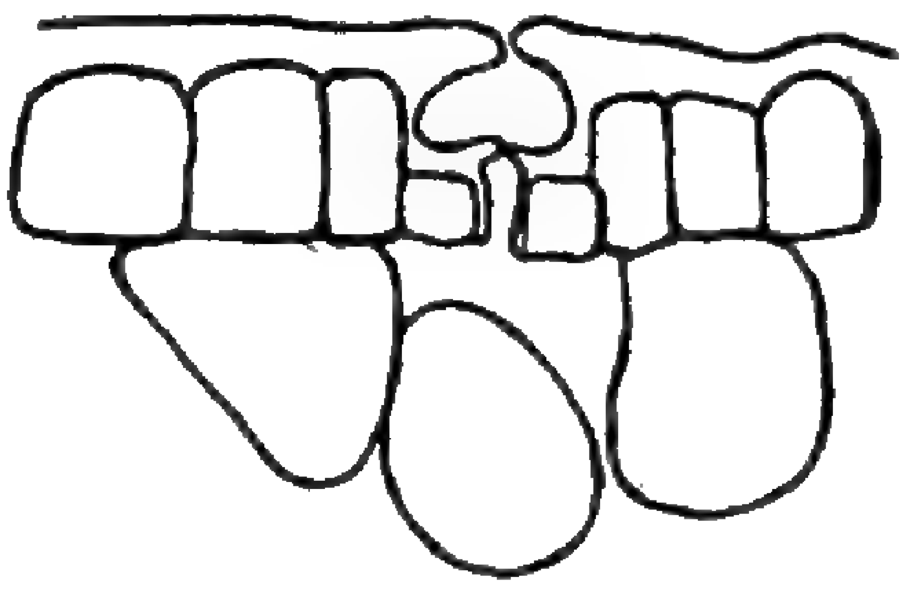
beyond the cell over the aperture, forming an outside chamber or vestibule (fig. 16 *a*). In other cases the guard-cells are sunk below the general level of the epidermis and the cuticular expansions project from the adjacent epidermal cells; in extreme cases, *V. Traversii*, there are secondary expansions from the guard-cells in addition (fig. 16 *b*). This species though

Fig. 16 *a*.



Section of stoma of lower side of leaf of *V. Hectori*. × 435.

Fig. 16 *b*.



Section of stoma of lower side of leaf of *V. Traversii*. × 435.

having the most carefully protected stomata is not one of the most xerophilous in other ways. In the very highly xerophilous forms, *V. lycopodioides* etc., protection is rather attained by the reduction in the numbers of stomata than in such special guarding of individuals.

Hydathodes.—In general, hydathodes are characteristic of hygrophytes; and so their presence in such a xerophilous group as this is of considerable interest. Normal hydathodes occur in the less xerophilous Groups A, B, C, and F, even in the more modified forms of Group B. They do not occur in the other more xerophilous groups.

V. elliptica, a seaside species, has the terminal hydathode protected by the great thickening of the outer walls of the epidermis in this region and the reduction of the stoma. The species in Group C, *V. anomala* and *V. Traversii*, show also a process of reduction, not only in the size of the opening, which is very small, but also by reduction in the extent of the water-discharging tissue below.

Water-tissue.—This occurs in a few species of *Veronica*. The hypodermal layer may be very sharply differentiated from the rest of the mesophyll, as in *V. Lewisii*, but in other cases, especially in the less xerophilous species, it appears to be somewhat intermediate. Thus, in *V. salicifolia* a layer of cells occurs only differentiated by form, or rather more distinct in *V. elliptica* *.

* *Cf.* Huchedé (1907).

The most peculiar case is that of *V. monticola*, where the layers of large cells would seem to have this function. These cells contain very little chlorophyll, and it appears possible that they may also serve as a screen against the damage of intense insolation.

The hypodermal layer below the upper surface of the leaf in those species with reduced leaves probably also acts as a water-storage tissue. *V. Hulkeana* alone of the species examined shows a water-storage tissue on both surfaces of the leaf.

This tissue seems one which is affected in its development by environmental conditions. In comparing cultivated plants with those grown in their own country, where water-tissue is present, it is almost always better developed in the latter. This is noticeably the case with that on the lower surface in *V. Hulkeana.* Also native plants of *V. subalpina* showed some indications of this tissue, which do not appear in the leaves of cultivated plants.

Relations of the Groups.

Structurally the species examined fall into two series of increasing xerophily, leaving Group F out of consideration for the present. The long-leaved forms of Groups A and B form the first series. Those of Group A are only slightly xerophilous, but still have protected stomata and a reduced lacunar system. Water-tissue is developed in *V. Lewisii*, and *V. elliptica* has specially protected hydathodes.

The species of Group B agreeing in external features with those of Group A have thick cuticle and homogeneous mesophyll structure.

The short-leaved forms show a similar series of stages. In Group C such forms as *V. vernicosa* and *V. anomala* show little special adaptation; they possess hydathodes and normal mesophyll. A further stage is reached in *V. Traversii*, with its protected stomata, somewhat homogeneous mesophyll, and reduced hydathodes. In *V. pimeleoides* and the species of Group D further adaptations have taken place; the mesophyll is quite homogeneous and palisade-like, with a very small lacunar system, and hydathodes have been suppressed. From a study of the reverted forms of *V. cupressoides* etc., it would seem that these forms, Group E, are modified from those of Group D; so that Group E would form the final stage in the series of increasing xerophily.

As was mentioned above, the conditions of environment of the groups show the same stages of increasing xerophily. It is interesting to note how similar the structure reached in *V. rakaiensis* (Group B)—the culmination of the xerophilous evolution of the larger-leafed forms—is to that occurring in some forms of Group D, such as *V. buxifolia.*

Comparison of Floristic with the suggested Anatomical Classification * †.

(The letters indicate the groups founded on leaf-characters.)

Subgenus I. Hebe.

A. **Integræ.**

Racemes long. I.

Species	Group
V. Cookiana.	A.
V. salicifolia.	A.
V. Lewisii.	A.
V. parviflora.	A.
V. Pseudotraversi.	B.

Racemes short. II.

Species	Group
V. Menziesii.	D.
V. Colensoi.	D.
V. elliptica.	A.
V. Darwiniana.	D.
V. Traversii.	C.
V. subalpina.	D.
V. vernicosa.	C.
V. monticola.	D.
V. buxifolia.	D.
V. anomala.	C.
V. carnosula.	D.
V. amplexicaulis.	D.
V. pinguifolia.	D.
V. pimeleoides.	C.
V. rakaiensis.	B.

Leaves dimorphic, imbricate when mature. III.

Species	Group
V. tetrasticha.	E.
V. lycopodioides.	E.
V. Hectori.	E.
V. Armstrongii.	E.
V. propinqua.	E.
V. cupressoides.	E.

Leaves small ; flowers terminal. IV.

Species	Group
V. epacridea.	E.

B. **Serratæ.**

Species	Group
V. Hulkeana.	F.
V. Lavaudiana.	F.
V. Fairfieldii.	F.

* Cheeseman (1906). † Wettstein, in Engler & Prantl (1895).

Subgenus II. EUVERONICA.	
V. loganioides.	E.
V. linifolia.	C.
V. catarractæ.	F.
V. Lyallii.	F.
V. Bidwillii.	F.

In the above table there are certain striking disagreements; perhaps the most striking is that of *V. loganioides* occurring in a different subgenus from the forms apparently allied to it anatomically. Cheeseman remarks that this is a plant of dubious affinity *, in that florally it approaches the herbaceous section of the genus, while vegetatively it is almost inseparable from some of the allies of *V. lycopodioides.*

Huchedé † arranged an anatomical table for the species he examined, based mainly on the arrangements of the bundles, especially in the petioles and leaf-base. This character was taken as being the one least altered in response to external conditions. This arrangement follows the Floristic Classification given above in the main; the chief exception is the separation of *V. Traversii* from its apparent allies to near *V. cupressoides,* owing to its having three bundles at the base of the petiole, unlike most of the other New Zealand species. He shows an interesting parallelism between the modifications of the New Zealand species and those of the Northern Hemisphere. He regards this analogy as the result of the effect of parallel conditions on pri mitively different species. This conclusion is further borne out by the close structural analogies between species of *Veronica* with plants of entirely different affinities. The most striking are those of the highly modified species, or "whip-cord" *Veronicas*; thus, *V. tetragona* was originally described as a species of *Podocarpus* under the name of "*P. Dieffenbachii*" ‡. Externally it is very like a large-leafed form of *Podocarpus cupressinus*, but structurally there are great differences. In leaf-stucture it is very similar to *Lycopodium quadrangulare*, in which species the epidermis is similarly modified, though not nearly to the same extent. Again, both in form and structure there is great similarity between *V. cupressoides* and *Cupressus sempervirens*, where the xerophilous adaptations of the epidermis, stomata, and mesophyll are very similar. Some species of *Crassula*, e. g. *C. lycopodioides*, show a strong external resemblance to some of the "whip-cord" *Veronicas*, and bear much the same relation to other species of the genus; but in leaf-structure there is always great difference between the two genera. Numerous other examples might be cited, showing a parallelism of

* Cheeseman (1906). † Huchedé (1907).
‡ *Cf.* Goebel (1908).

development both with regard to the highly modified forms and those that are less so.

Goebel * considers that in the "whip-cord" forms the reduced leaf really represents only the leaf-sheath, and that the lamina is represented by the stiff points seen, for example, in *V. lycopodioides*. Consideration of seedlings and of the "reverted" form of leaf certainly tends to confirm this view. Again, the arrangement of the vascular bundles in the "leaf" of these forms, e. g. *V. Hectori*, is practically identical with that of the vagina in the less modified species.

The cork developed at the leaf-base seems to be formed abnormally early, in preparation for the fall of the leaf. The absciss-layer is just above the patch of cork-cells. The patch arises just as that below an ordinary absciss-layer †, and only differs in amount and its time of production.

In conclusion, I desire to express my sincere thanks to Professor Seward and to Mr. A. G. Tansley, for their kind help and suggestions during the progress of this investigation.

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* Goebel (1900). † Massart (1898).

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On the Brown Seaweeds of the Salt Marsh.

By Sarah M. Baker, B.Sc., University College, London. (Communicated by Prof. F. W. Oliver, F.R.S., F.L.S.)

(Plates 8 & 9 and 8 Text-figures.)

[Read 6th April, 1911.]

The importance of certain Algæ, such as, e. g., *Rhizoclonium* *, in relation to the colonisation of tidal flats by higher plants and the establishment of salt marshes has long been recognised. In the present paper an account is given of certain Fucoideæ which, in some respects, appear to function in a similar manner.

The two algæ to be described were found originally in Sept. 1907 by Prof. F. W. Oliver on the salt marshes adjoining the experimental station at Blakeney Point, Norfolk.

The locality in question consists essentially of a system of shingle-banks and sand-dunes, which form a peninsula, westwardly directed, several miles in length, ending at Blakeney Point. Under the protection of these banks and dunes, on the southerly side, a series of salt marshes or saltings have established themselves. The sketch-map (text-fig. 1) shows part of the area. It is on the marshes just within the actual point that our algæ form so conspicuous a feature, where, mingled with the halophytes, they stretch over an area of some 60 to 70 acres.

The general character of the habitat is shown in Pl. 8. fig. 1. On the right are the dunes, ending at Blakeney Point, not far from the flagstaff seen on the skyline. In the centre of the figure, contained between two shingle-banks (shown at the left-hand side of the sketch-map, text-fig. 1) dotted over with shrubs of *Suæda fruticosa*, is the level sward, largely composed of *Salicornia europea*. It is on the ground between the stems of the halophytes that the algæ occur; in this particular stretch of marsh mainly the free-growing *Pelvetia* (*cf.* Pl. 8. fig. 2). In parts not shown in the photograph the forms of *Fucus* abound, but the general character of the ground is essentially similar.

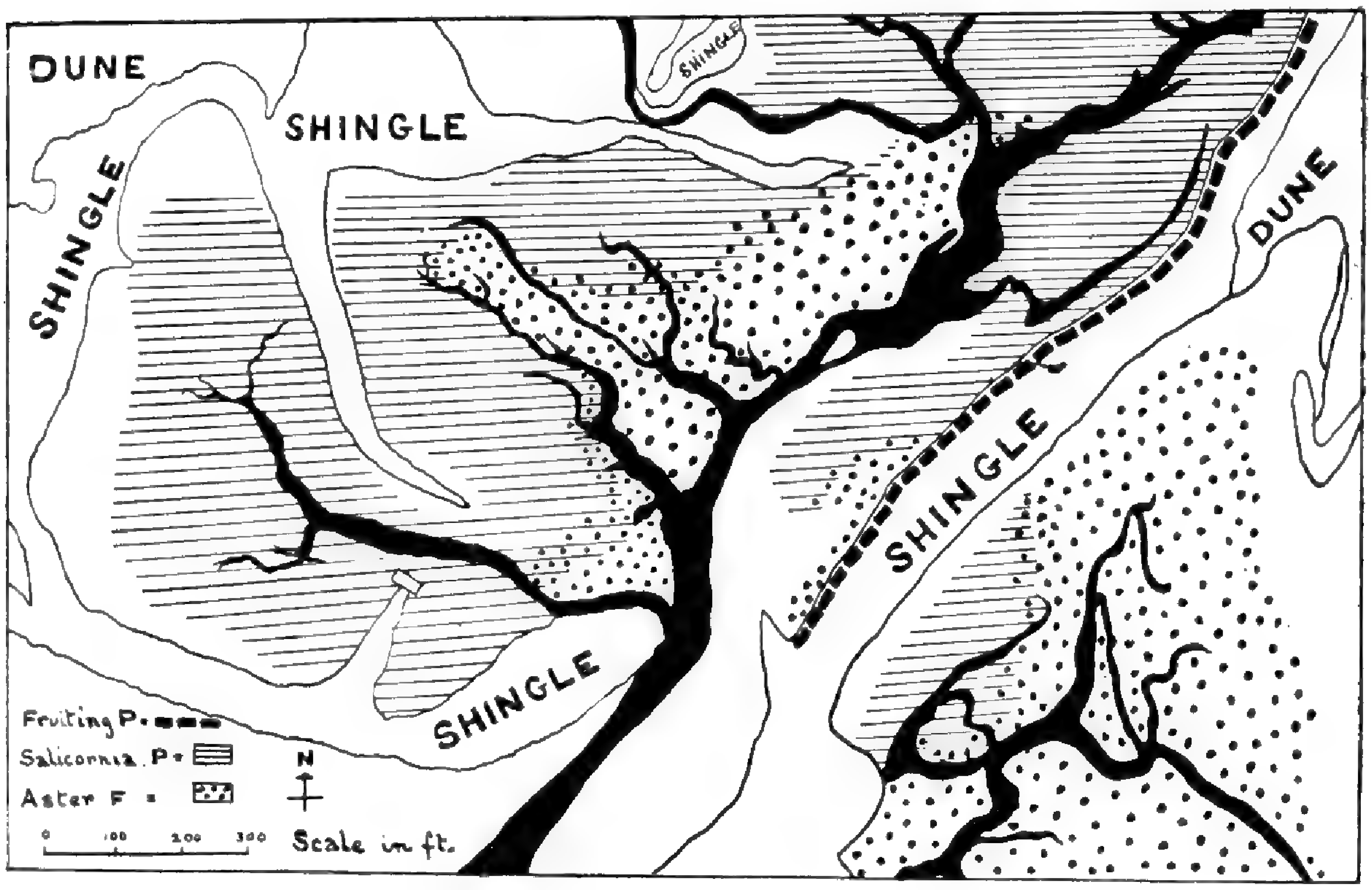
The vegetation covering the marsh was, on the whole, very uniform. The higher parts were occupied by *Salicornia europea*, in close formation, with *Suæda maritima* and *Aster* plants occasionally. The borders of the marsh, somewhat higher ground, were occupied by an association in which *Obione portulacoides* predominated, and stray members of this association were also found on the actual marsh. The *Salicornia* association gradually

* N. Wille, 'Studien über Chlorophyceen I.-VII.,' Christiania, 1901, p. 37.

disappeared on the lower levels of the marshes, and its place was taken by an association in which *Aster Tripolium* predominated, but *Suæda maritima*, *Salicornia europea*, and *Statice Limonium* were also present.

The algæ were associated with the phanerogams in a very striking manner. Round the *Salicornia* was a closely-knit network of an unattached form of *Pelvetia canaliculata* (seen at *α*, Pl. **8.** fig. 1). This formed a continuous covering to the ground, and through it the phanerogams grew up. But as the *Salicornia* association gave place to the *Aster* association, the occurrence of *Pelvetia* became less frequent, and in its place a small spiral *Fucus* was

Fig. 1.



Sketch-map of part of the marshes at Blakeney Point, Norfolk. The creeks are represented in black. The *Pelvetia-Salicornia* association is shown by line-shading, the *Fucus-Aster* association by dotted shading. The zone of fruiting *Pelvetia* is shown by a heavy broken line. The left-hand third of the area charted forms the subject of Pl. **8.** fig. 1.

found embedded in the mud, the *Fucus* appearing first along the banks of the creeks. Irregular shaped patches of a smaller form of *Fucus* were also found among the Salicornias in the *Pelvetia* zone, but the *Salicornia* was much smaller when growing with *Fucus* than *Pelvetia*. In the sketch-map (text-fig. 1) the general distribution of the two associations is shown. The *Salicornia-Pelvetia* association is represented by means of line-shading, the *Aster-Fucus* association by dots.

The algæ to be described are two forms of *Pelvetia canaliculata*—one growing entirely without attachment among the halophytes; the other

growing embedded in the soil of the marsh and presenting a coralline appearance ; and a spiral *Fucus* also growing without attachment, embedded in the soil, and a variety of the same *Fucus* which has a broad and much crinkled thallus.

Pelvetia.

Mode of Growth and Occurrence.—At Blakeney two forms of *P. canaliculata*, besides the normal attached form, were found. The first (text-figs. 2 & 3) is entirely without attachment, either to the soil or to the plants among which it grows. The plant is about the same size as when growing on a stone, but it is usually more profusely branched. The most striking characteristic feature is the curling of the younger parts of the thallus. This curling seems to be away from the ground as the plant rests in its natural position, and, together with the luxuriant branching, gives it a dense bushy appearance. Also the curled branches of neighbouring plants are interlaced as they lie on the ground, so that a more or less continuous matting is formed over the marsh. Pl. 8. fig. 2 is a photograph showing *Salicornia europea* growing with this loose *Pelvetia*. The colour of the unattached variety of *Pelvetia* is considerably darker than that of ordinary attached plants, varying from dark brown to olive-green. It is not displaced by tidal inundation.

Reproduction.—This alga has been observed by Prof. F. W. Oliver at several seasons of the year, and the reproduction seems to be almost, if not entirely, vegetative, by means of budding from various parts of the thallus. Small tufts of such buds are shown at α and β in text-fig. 2. Apparently the parent plant gradually dies away, leaving the younger shoots to occupy its position.

After extensive search, a small fragment of unattached *P. canaliculata* was found, fruiting in the normal way, among the sterile plants on the marsh ; but it is quite possible that this was merely a fragment torn from the stones in the neighbourhood, where there is a zone of normal *P. canaliculata*. The same specimen also showed vegetative budding, as well as the receptacles, but the occurrence of such budding is by no means uncommon in the ordinary attached plant.

Relation of the loose Pelvetia *to Fruiting Specimens.*—The origin of this extensive matting of *Pelvetia* is a matter of some interest. Along the north-western side of the tongue of dune and shingle which intersects the marsh (text-fig. 1, on right) there is a narrow zone, about 1 to 2 feet wide, of *P. canaliculata* attached to pebbles and fruiting in the normal way, represented in the sketch-map (text-fig. 1) by a heavy broken line. This at once suggests itself as the original source of the *Pelvetia* on the marsh ; but whether the loose form arose originally by the germination of oospores carried

over the marsh by the tide, or from young plants torn off the stones and caught in the vegetation of the marsh, is hard to determine.

Artificial Cultivations oj Pelvetia.—In the summer of 1910 a few experiments were attempted in order to find out what effect certain physical and

FIG. 2.

Habit of *Pelvetia canaliculata*, var. *libera*. α and β show bunches of adventitious shoots. $\times 1\frac{1}{3}$.

chemical factors had on the growth of *P. canaliculata*. A series of cultures was made with young plants, both from stones and from the marsh. The plants were placed in glass vessels and covered with sea-water at suitable intervals,

the water being removed by siphons to avoid disturbing the cultures. In order to obtain the effect of the spring- and neap-tides the time per diem under water was varied according to the following scheme :—

For	2 days	in water	1 hr.	in twelve.	
,,	2	,,	,,	2 hrs.	,,	
,,	3	,,	,,	3 hrs.	,,	(spring-tide).
,,	2	,,	,,	2 hrs.	,,	
,,	2	,,	,,	1 hr.	,,	
,,	3	,,	,,	0 hrs.	,,	(neap-tide).

FIG. 3.

Fragment of a plant of *Pelvetia canaliculata*, var. *libera*, to show curling of thallus. × 2.

In this way an equivalent spring- and neap-tide was obtained, each recurring once a fortnight, and the working was not complicated

The cultures may be tabulated as follows. The salts mentioned were added to sea-water made up from 37 grms. of Tidman's Sea Salt per litre. Absorbent cotton-wool was used to imitate a surface holding gradually concentrating solutions :—

1. *Pelvetia* (loose) laid on wool. Na_2HPO_4 0·5 grm. per litre.
2. *Pelvetia* (cut off stones) laid on wool. KNO_3 1 grm. per litre.
3. *Pelvetia* (attached to stones). KNO_3 1 grm. per litre.
4. *Pelvetia* (cut off stones) laid on wool. Green light.
5. *Pelvetia* (attached to stones). Green light.
6. *Pelvetia* (cut off stones) laid on wool.
7. *Pelvetia* (loose) laid over pebbles.
8. *Pelvetia* (attached to stones) laid on wool.
9. *Pelvetia* (attached to stones) check.

Two other cultures were made in which the tides were reversed, *i. e.* the plants were under water when the rest were dry, putting them in effect in a position on the beach just below the low-water mark of the neap-tides :—

10. *Fucus* (from marsh) over pebbles.
11. *Pelvetia* (attached to pebbles).

Remarks on the Cultures.—The original idea was to see whether there was a necessary connection between the attachment of the alga and its fruiting ; but as, after six weeks, none of the cultures showed any signs of producing receptacles, they were discontinued. It may be that the plants can be induced to fruit by a more careful choice of conditions, but at present the results are negative. In spite of this, however, one or two points can be gathered from the cultures.

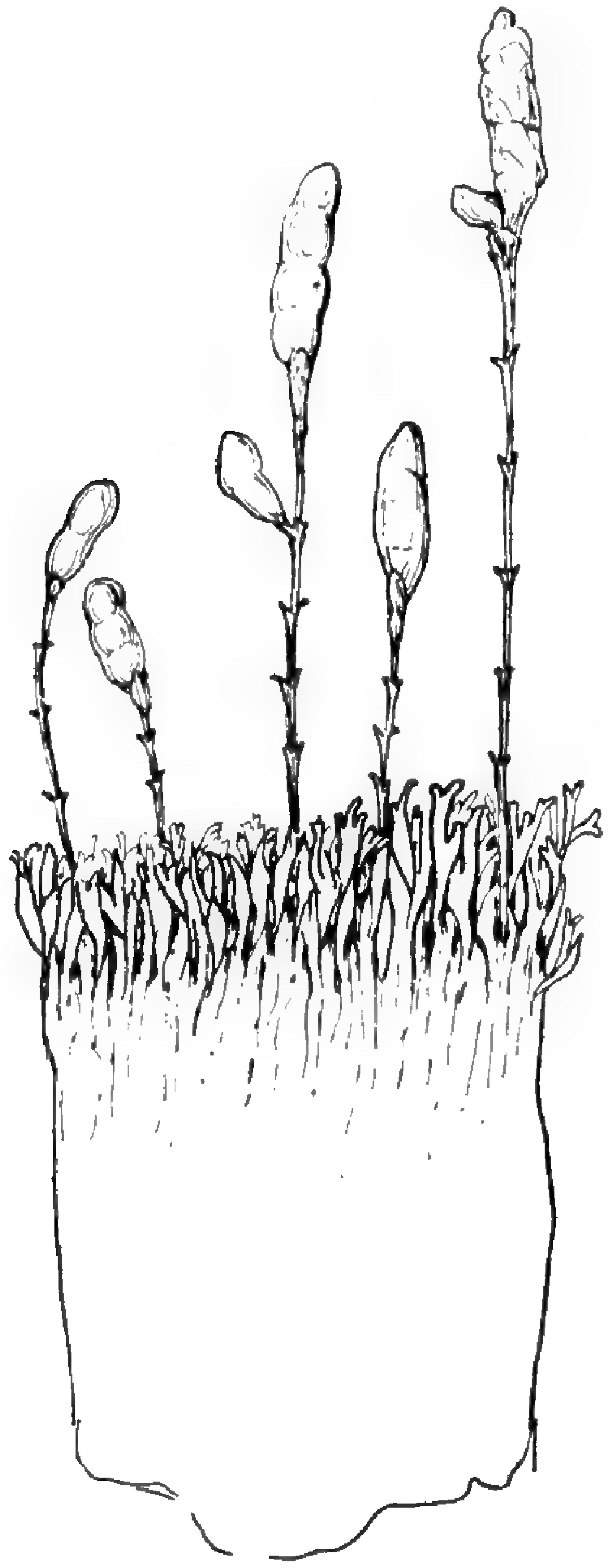
The experiments were begun on July 24, 1910. On August 24 culture 11 (*Pelvetia* below the low-water mark of the neap-tide) was obviously quite dead, having been apparently almost lifeless for about a week ; none of the other cultures were dead. On Sept. 7, none of the other cultures were dead. This shows that *Pelvetia*, unlike the *Fuci* investigated earlier *, will not grow under the tidal conditions obtaining on the lower part of the shore. The reason of its confinement to the upper parts of the beach is, that it will not tolerate too long an exposure to sea-water.

A second point to be noted is that in culture no. 2 (*Pelvetia* from stones lying on a surface constantly charged with KNO_3 solution) there was, at the end of the time, Sept. 7, a decided tendency to curl at the ends of the fronds ; also, of thirteen plants, three had produced vegetative buds. The curling was very slight compared with that of the loose form of *Pelvetia*, but it was not observable in any of the other cultures. No change was apparent in the form of either the loose *Pelvetia* or *Fucus* after the treatment. The curling of the thallus observed in culture 2, where it was in contact with a surface constantly charged with nutrient salts, may be something akin to what has happened on the marsh, where a stray plant with such a curling tendency would soon become entangled in the vegetation and form the nucleus for

* 'New Phytologist,' vol. viii. p. 201.

a marsh formation of *Pelvetia*. However, the results must be taken with caution, because, had the conditions been wholly favourable, fruiting would have occurred in the cultures.

FIG. 4.



Pelvetia canaliculata, var. *coralloides*, growing with *Salicornia europea*. Nat. size.

The Coralline Form of Pelvetia.—Another form of *P. canaliculata* was found embedded in the soil, about 2 cm. of it protruding from the surface. Text-fig. 4 shows this form growing with *Salicornia europea*. The appearance of the frond was similar to the normal attached *Pelvetia*. Foslie describes a variety, *P. canaliculata*, var. *radicans* *, which grew gregariously in shallow pools, the lower part of the frond being provided with rhizoids, by means of

* K. Norske Vidensk. Selsk. Skriften, 1891, p. 263. Trondhjem, 1892.

which it was attached to the clay bottom of the pools. In size the plant of Foslie was about the same as the normal attached *Pelvetia*. The habit of this var. *radicans* seems to be somewhat similar to the coralline form at Blakeney, but does not correspond in all respects. The coralline *Pelvetia* was only very occasionally found, possibly because the loose-lying form usually obscured it.

Relations of the Free Form of Pelvetia *with* Salicornia.—The effect of the extensive matting of *Pelvetia* on the growth of *Salicornia* is well shown by a series of experiments, of which notes have been handed me by Prof. Oliver.

On *October* 24, 1908, before the *Salicornia* had shed its seed, an area 10 feet square was cleared of *Pelvetia* and staked. The *Salicornia* was left, and no doubt scattered its seed a few weeks later *.

July 14, 1909.

Staked area showed :

1. Fewer plants within than outside—roughly about one-fifth.
2. Plants within averaged 2–3 in. in height, those outside about 5 in.

This difference in height became very evident when the tide rose, those without standing up 2 in. above the surface, while those within the area were entirely covered.

November 6, 1909.

Salicornia within sparser than without ; the plants were erect, whilst most of those outside, especially where they grew densely, were lying on their sides.

About 100 plants were collected at random from within and without, and statistical determinations of the plants of the two batches were carried out as follows † :—

Results.

	Without *Pelvetia*.	With *Pelvetia*.
Average length..........	14·07 cm.	17·97 cm.
Average diameter........	4·40 mm.	4·53 mm.
Total wet weight........	182 grms.	220 grms.
Total dry weight........	33 "	42 "

115 plants of each batch taken.

* The area was just to the right of the large stranded smack 'Britannia,' seen on the left of Pl. 8, fig. 1.

† The measurements were made by Miss M. H. Bohling, of University College.

The effect of this matting of *Pelvetia* on the growth of *Salicornia europea* is shown to be decidedly favourable. How this effect is produced is not so clear. It is not easy to see how an entirely unattached living layer of plants could become an efficient manure. Also when the embedded *Fucus*, which rots below and thus affords manure, grows with *Salicornia* there is rather a dwarfing of the *Salicornia* than otherwise. The cause is probably to be sought in the decreased evaporation from the surface of the soil, and slightly increased temperature, produced by the *Pelvetia*, which acts as a surface mulch. It is hoped that further experiments may throw some light on this subject.

Zoning between the Free Pelvetia *and the* Fucus.—In the lower parts of the marsh, as *Salicornia* is replaced by *Aster Tripolium*, the place of *Pelvetia* is taken by a small spiral *Fucus*. Between the entirely loose *Pelvetia* and the embedded *Fucus* there is quite a comparatively definite zoning observable, which is all the more interesting as the differences in level involved are very small, a few inches at most. The spring-tides apparently only covered the *Aster* zone 10 to 15 minutes earlier than the *Salicornia* zone. The number of tides covering the areas is probably the determining factor, not the exposure per diem.

THE EMBEDDED *FUCUS*.

The small spiral *Fucus* found in the lower regions of the marsh, among the *Aster* association chiefly, is not by any means a new form. Among others, Hudson *, Goodenough & Woodward, and Turner † have described it in England ; and a closely similar species, occurring at Arcachon in France, has been described and discussed very fully by Prof. C. Sauvageau under the name of *F. lutarius* ‡, a species established by Kützing §.

The general morphology of our plant is almost identical with the *F. lutarius* of Sauvageau, with specimens of which he has most kindly supplied me. The thallus is extremely spirally twisted, and bears cryptostomata on the margins at frequent intervals, and often scattered over the rest of the thallus. A comparison of Pl. **8.** fig. 3 and Pl. **9.** fig. 4 and text-figs. 5, 6, 7, & 8 with figs. 16–19 of Sauvageau's paper (*loc. cit.*) will show the great similarity of the two forms.

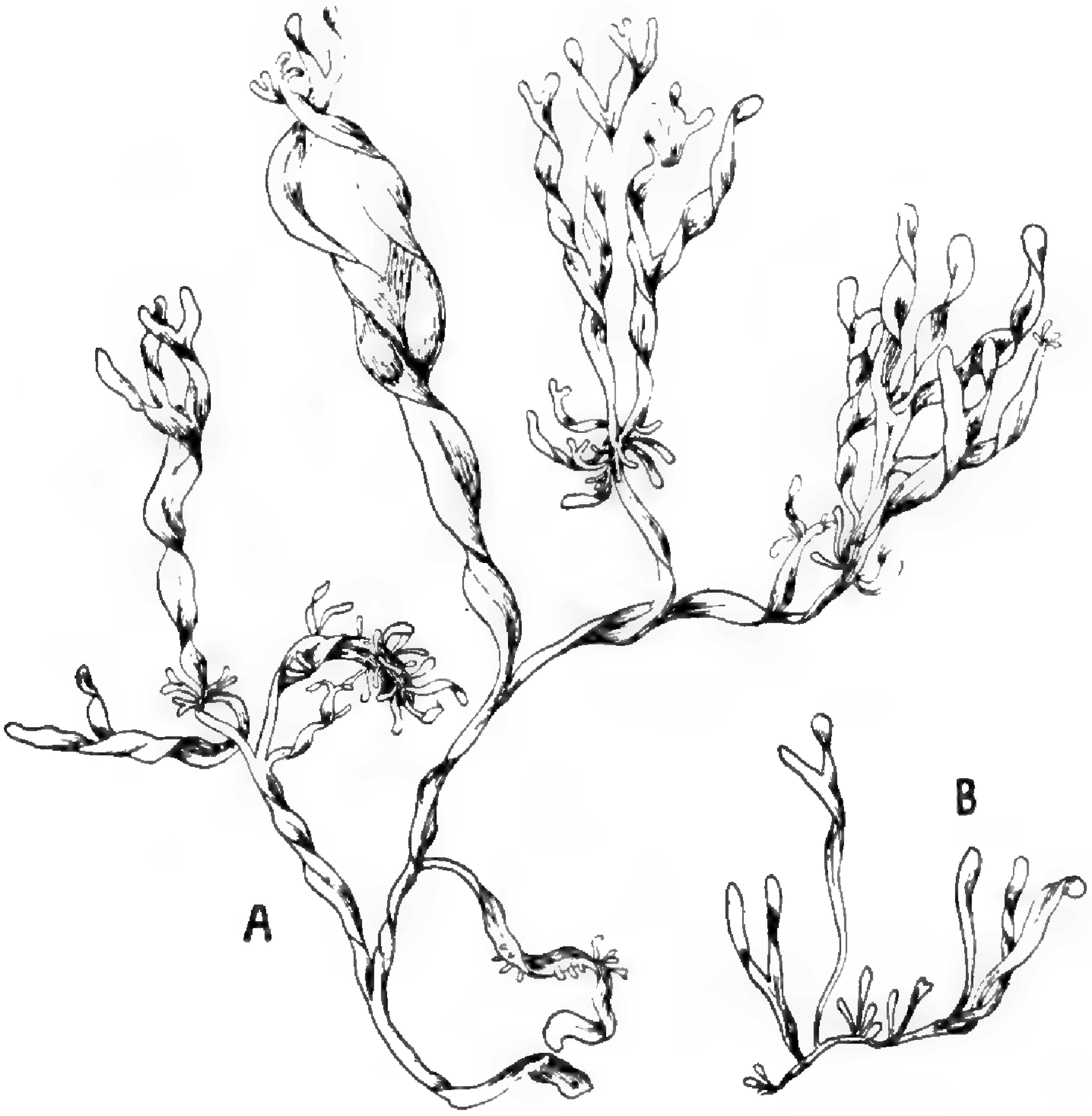
Mode of Growth and Occurrence of the English Fucus.—The plant found at Blakeney (text-fig. 5, A) varied in length from 5–12 cm. It was much spirally twisted and grew embedded in the soil, numerous adventitious shoots

* 'Flora Anglica,' p. 577. London, 1778.
† 'A Synopsis of the British Fuci,' vol. i. p. 127. London, 1802.
‡ Bordeaux Société Scientifique d'Arcachon, Travaux des Laboratoires, 1908, pp. 106–153.
§ Kützing, Tabulæ Phycologicæ, vol. x. p. 7 & pl. xvii. Nordhausen, 1860.

being formed from the lower parts of the thallus. It bore oblong vesicles occasionally, but they were never numerous. A few luxuriant specimens were found fruiting in July 1910.

In the autumn of 1910 Prof. F. W. Oliver found a luxuriant growth of this *Fucus,* associated with *Spartina Townsendii,* on a salt marsh behind the Hurst Castle shingle-bank near Southampton. The plant was similar to the Blakeney plant, but reached much more luxuriant proportions. The plants

FIG. 5.



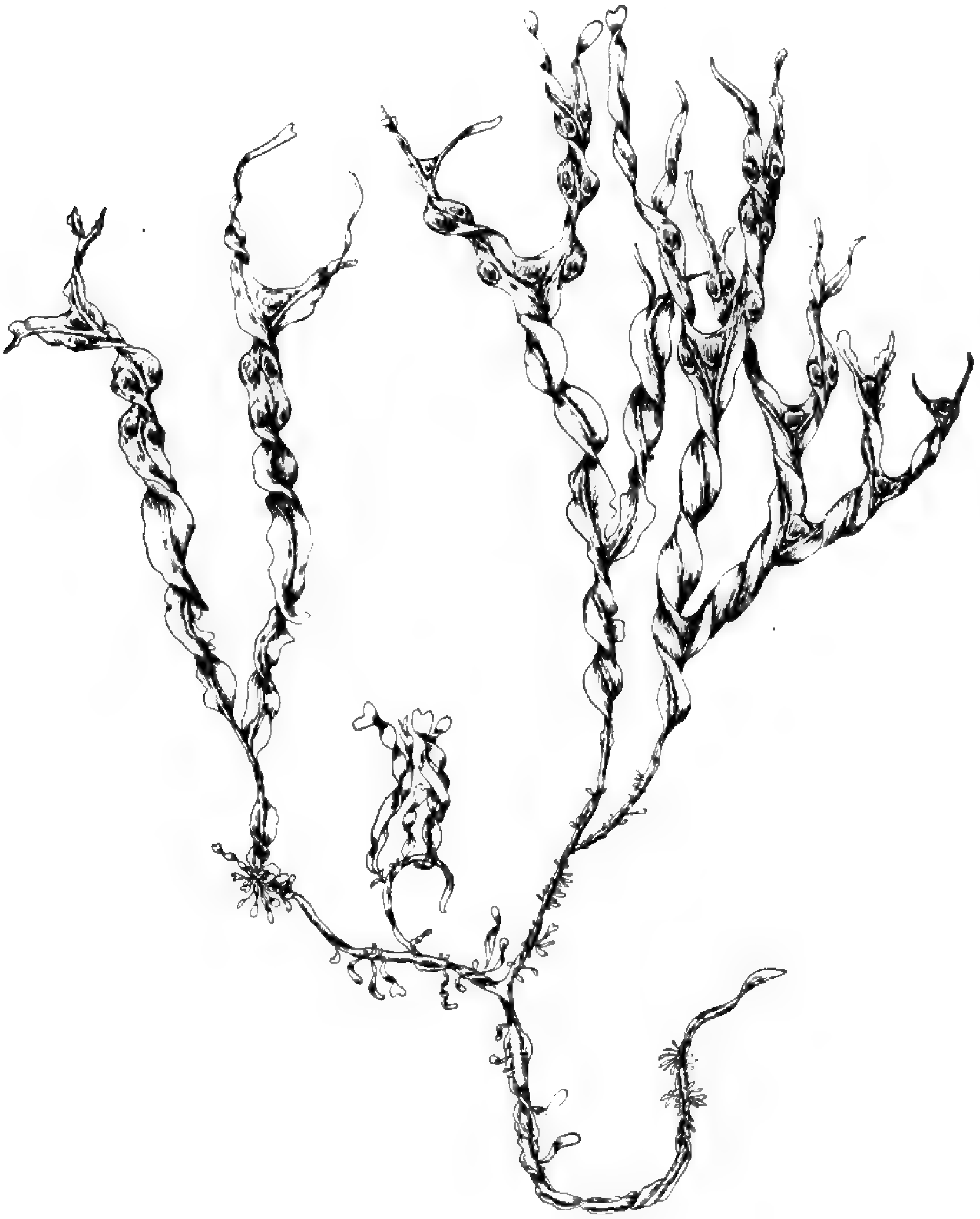
A. Habit of *Fucus volubilis* from Blakeney Point growing with *Aster Tripolium.* Nat. size.
B. *Fucus* as growing with *Salicornia europea,* probably a smaller variety of *F. volubilis,* but possibly *F. lutarius.* $\times 1\frac{1}{3}$.

from Hurst Castle fell naturally into three groups. One, light brown in colour, with many vesicles, arranged as in the specimen figured (text-fig. 6), the thallus being about 20 cm. long and 3 mm. broad. A second group of plants were very spiral, pale yellow in colour, the edge of the thallus being beset with cryptostomata, without vesicles, or with very occasional ones: length of thallus 13 cm., breadth 2 mm. In the third group the plants were less spiral, vesicles very sparse, rhachis bare a long way up: length of

thallus 10–16 cm., breadth 3–4 mm. No receptacles were found on any of the plants. The *Fucus* covered a large area of the marshes.

In December 1910, in the marshes of the Blackwater, Mersea Island, Essex, near the spot where Hudson found his specimens, numerous plants, also of

FIG. 6.

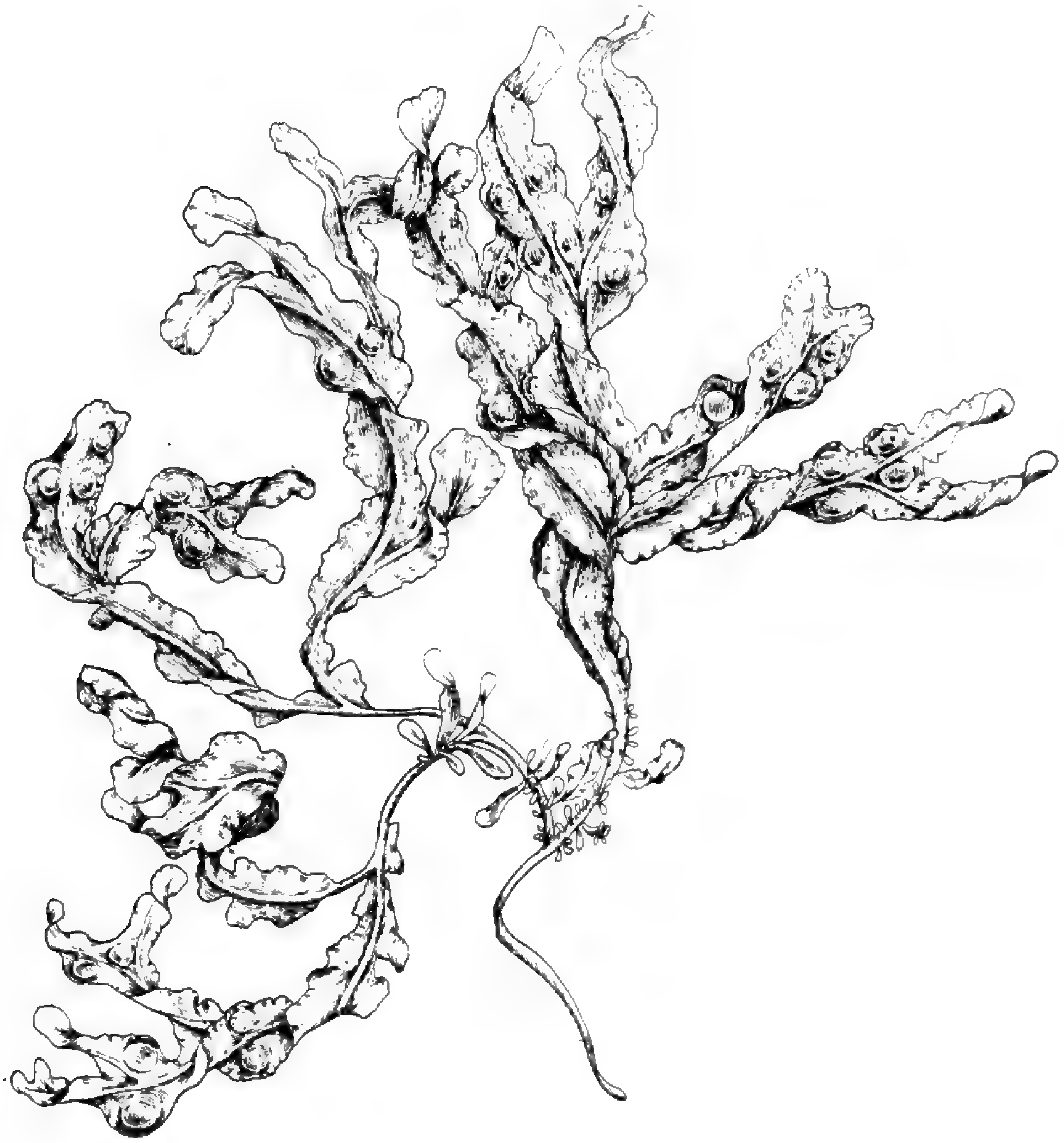


Fucus volubilis as found at Mersea Island, Essex. The figure shows an old weather-worn specimen; in many plants the tops of the shoots are entire. × ½.

like habit, were found, but they did not densely cover the ground as at Hurst Castle. The plants were either embedded at one end in the mud and growing out of it in clusters on the banks of creeks, &c. (Pl. **8**. fig. 3 and Pl. **9**. fig. 4), or entirely loose and tangled among the *Aster* plants. They seemed

to correspond exactly with the plant described by Sauvageau * from Port de Boria, San Vicente de la Barquera, N. Spain. They were much larger than the Blakeney plants, but of a similar habit (text-fig. 6), varying from 16 cm. to about 80 cm. in length and 4–8 mm. in breadth. They were usually found with numerous vesicles, arranged as in the figure, though occasional plants had no vesicles. The figure represents the characteristic appearance

FIG. 7.



Fucus volubilis, var. *flexuosus*. $\times \frac{1}{2}$.

of old weather-worn plants, showing the great delicacy of the wings of the thallus. In the young growing plants the ends of the thallus are perfect, and show numerous cryptostomata on the margins and scattered over the tip of the frond.

In May 1911 (since communicating the above) the Mersea Island marshes

* Sauvageau, in Bordeaux Soc. Sc. Arcachon, Trav. Lab. 1908, pp. 106–153, fig. 16.

were further investigated, and a whole series of forms was found, ranging from 3 or 4 cm. in length and 1 mm. in breadth to the above dimensions. Usually the upper levels were occupied by small or narrow varieties, but the formation was often mixed. The plants were both with and without vesicles. Receptacles were also found on a few of the large specimens. The different forms approached *F. lutarius* and *F. vesiculosus* respectively in habit.

A certain number of plants were found with a broad and much crinkled thallus (text-fig. 7), which were so distinct in form as to be included under a separate variety. The length was about 16–20 cm. and breadth about 15 mm.

The very tiny *Fucus* (text-fig. 5, B) found in the *Salicornia* region of the marsh at Blakeney seems very similar in habit to the smallest varieties of *F. volubilis* found at Mersea. It grows in large patches, which might all have been produced by the growth of one individual. It is possible, however, as it occupies a different zone from the other *Fucus*, that it may be derived from a different species; and hence corresponds with the French form, *F. lutarius*. Its receptacles have not been found. It bears no vesicles.

The Affinities of the Fucus.—The *Fucus*, like the *Pelvetia*, reproduces almost entirely by vegetative budding, the buds being produced on the embedded part of the thallus, which rots away later, leaving the young shoots to occupy its place. A small number of receptacles were found on some of the largest Blakeney specimens. Turner, in his description of plants found near Wells, Norfolk, mentions the occasional occurrence of receptacles, but does not describe them in detail. Of the receptacles examined four were male and the rest female. The paraphyses do not project at all from the mouth of the conceptacles (Pl. **9**. figs. 5 & 6). In shape the receptacles are either short and round or long and narrow and almost pointed (text-fig. 8); they are either inflated with mucilage, or the interior is filled with air and a confused tangle of hyphæ. They are simple or bifid, but always strictly terminal. The antheridia seemed to be represented merely by swellings on the short branched hyphæ (Pl. **9**. fig. 5). The oogonia were remarkably small and usually undivided; a few occasional ones were found which had divided once, and were arranged like a *Pelvetia* oogonium, and a few in which they had divided a second time; a section through such an oogonium is shown in Pl. **9**. fig. 6 at *a*. Of course, the limited supply of material makes the results more doubtful; but it appears as though the oogonia were abortive or not fully developed, which Sauvageau has found to be always the case among the very numerous examples of the French *F. lutarius* he has examined.

The English species is thus different from the French *F. lutarius* in several most important points. The paraphyses of the French species project very considerably from the ostioles of the conceptacles, and, among hundreds of

specimens, no single male receptacle has been found. It also bears no vesicles. Sauvageau has very fully discussed the affinities of his *F. lutarius* *, and decided that it was originally derived from *F. spiralis* † (*F. platycarpus*, Thur.), the hermaphrodite species with projecting paraphyses and no vesicles, the antheridia having been gradually reduced to nil. He suggested that the

Fig. 8.

Frond of *Fucus volubilis* from Blakeney Point, bearing receptacle. × 2.

vesicled English form, as also the Spanish one, was derived from *F. vesiculosus*, diœcious with non-projecting paraphyses; but was unable to decide with certainty, because no receptacles had been described. This surmise seems to be amply borne out by the nature of the conceptacles found. It is, at any rate, pretty obvious that these two almost identical plants cannot

* Bord. Soc. Sc. Arc., Trav. Lab. 1908, p. 137.

† Börgesen, in Journ. Linn. Soc., Bot. vol. xxxix. (1909) p. 105.

belong to the same species, the differences between them being precisely the specific differences between *F. spiralis* and *F. vesiculosus*.

Whether either of the unattached *Fuci* merit the rank of a species, distinct from the one whence they are derived, is another question which I am not in a position to answer. Sauvageau considers the French *Fucus* as a distinct species, *F. lutarius*, and suggests the name *F. volubilis*, originally given by Hudson for the English one. As the plant has so many different forms and such a wide range, it may be convenient, for the present at any rate, to follow this suggestion instead of multiplying the varieties of *F. vesiculosus*. If the two plants are found later to be merely varieties of *F. spiralis* and *F. vesiculosus* respectively, it would be well to represent them as *F. spiralis*, var. *lutarius*, and *F. vesiculosus*, var. *lutarius*, to indicate the very great similarity between them. It is extremely interesting to find two separate species giving rise to forms so nearly identical, that, without the receptacles, it is impossible to tell certain specimens apart.

Diagnoses of the Varieties described.

PELVETIA CANALICULATA, var. LIBERA, *S. M. Baker*, var. nov. [Figs. 2, 3.]

Plant not attached in any way, from 10–15 cm. in length, producing numerous adventitious buds from various parts of the thallus. Frond possessing the characteristic channelled form of *P. canaliculata*, profusely branched by dichotomy, the growing ends much curled, dark brown or olive-green in colour. Receptacles not known with certainty.

Hab. Among the higher plants, notably *Salicornia europea*, of sheltered salt marshes, Blakeney, Norfolk.

P. CANALICULATA, var. CORALLOIDES, *S. M. Baker*, var. nov. [Fig. 4.]

Plant embedded in mud, from 1–4 cm. in length, producing adventitious buds from lower parts of thallus. Frond channelled, branching sparse, thallus somewhat curled. Receptacles unknown.

Hab. Sheltered salt marshes, Blakeney, Norfolk.

FUCUS VOLUBILIS, *Huds.* [Figs. 5, 6, 8.]

Plant not fixed by a disc, embedded in mud or unattached, from 4–80 cm. Vesicles numerous in the larger plants, but often absent or few in the smaller ones. Numerous adventitious buds produced from the base of plant. Frond much spirally twisted, from 1–8 mm. broad, provided with numerous cryptostomata on the margins and over the tip of shoot. Receptacles elongated, oblong or almost pointed, occurring at the ends of the fronds, and hardly broader than the rest of the thallus, turgescent, with or without mucilage,

from 1–3 cm. in length, simple or bifid; of very rare occurrence. Plants diœcious, oogonia and antheridia apparently immature, paraphyses not projecting from the ostiole of the conceptacle.

Hab. On mud or sand, along the banks of creeks or among the phanerogams of salt marshes. English coast and N. Spain.

Fucus volubilis, var. flexuosus, *S. M. Baker*, var. nov. [Fig. 7.]

Plant not fixed by a disc, about 15–20 cm. in length; vesicles numerous. Frond much spirally twisted, from 10–16 mm. broad, with prominent midrib and much crinkled margin; producing numerous adventitious buds from the base. Receptacles unknown.

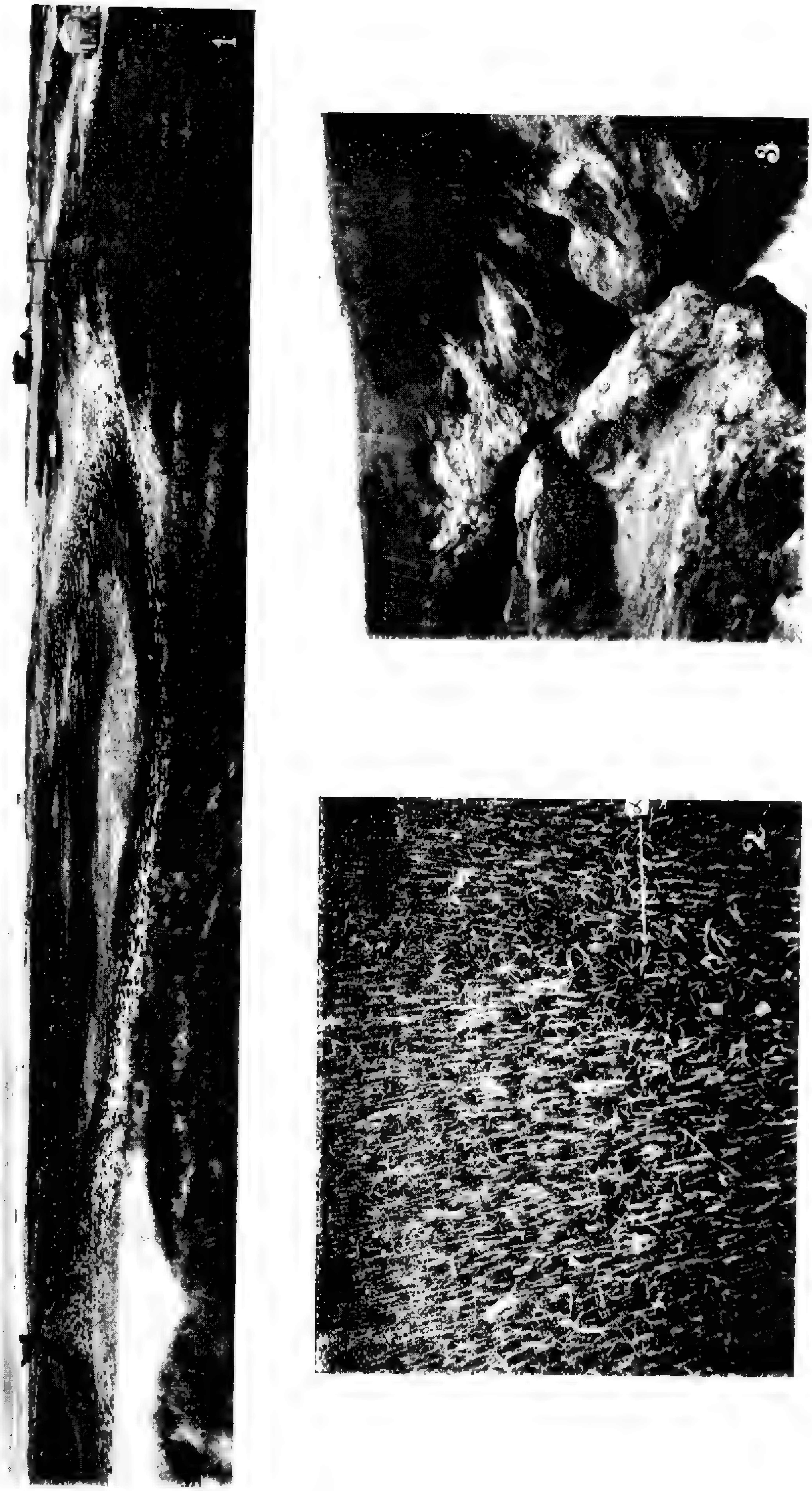
Hab. Among the phanerogams of salt marshes, Mersea Island, Essex.

Summary.

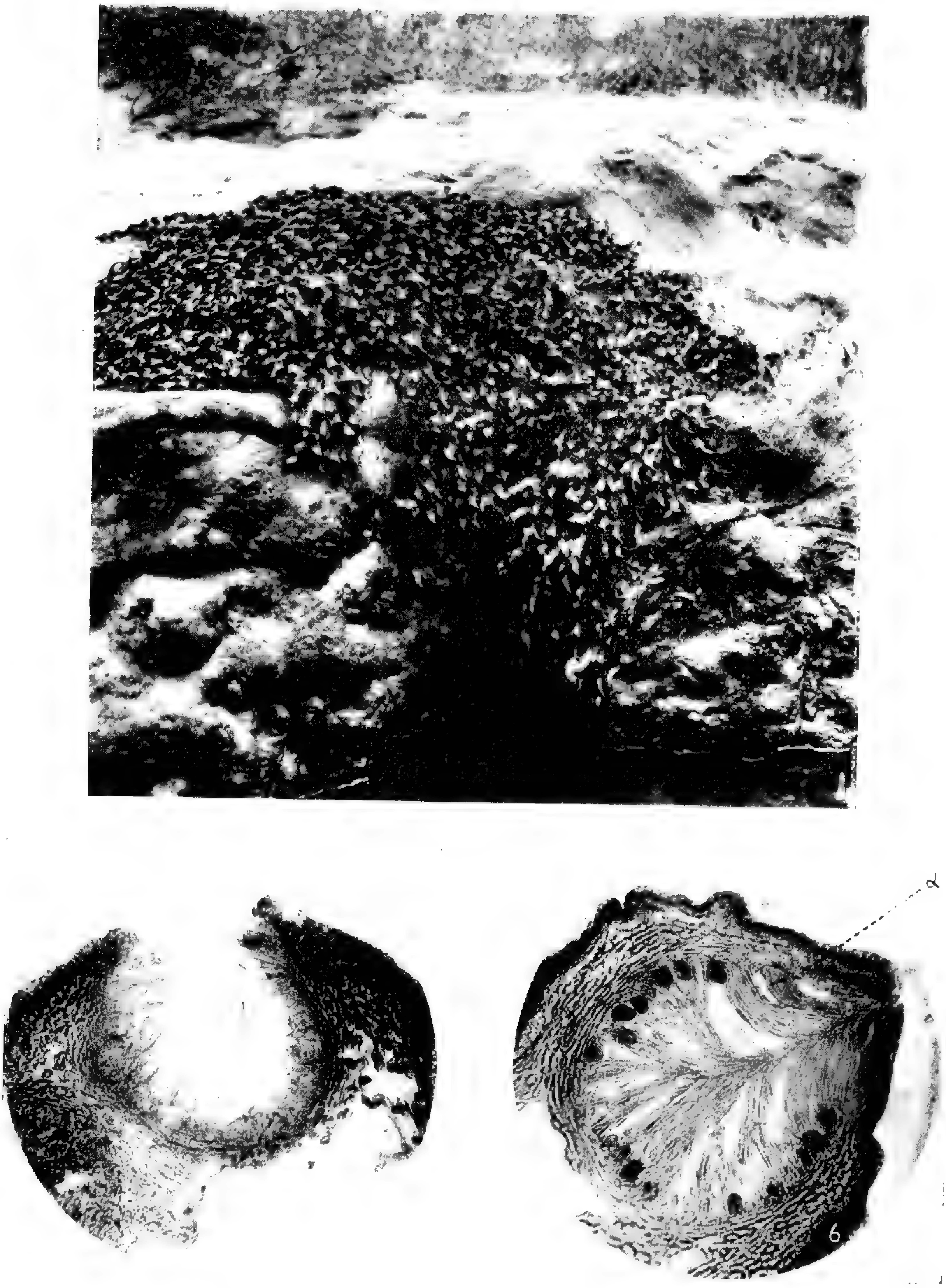
An entirely free-growing variety of *Pelvetia canaliculata* has been described, whose presence has been shown to be beneficial to *Salicornia europea*, probably acting as a surface mulch; as well as an embedded variety of less common occurrence. The receptacles of the spiral *Fucus*, found as early as 1778 by Hudson, have been described, and from their nature the deduction drawn that this *Fucus* is not derived from the same species as the almost identical *F. lutarius* of Sauvageau. A variety of this *Fucus*, of slightly different habit, has also been described. The zoning, observed at Blakeney, between the free-growing *Pelvetia* and the embedded *Fucus* is a point of interest.

In conclusion, I have to thank Prof. F. W. Oliver for placing in my hands information and notes on the Blakeney and Southampton Fucoids. I should like to offer my sincere thanks to Prof. Sauvageau for the many valuable specimens with which he supplied me, and to Mr. A. Gepp for giving me the opportunity of examining the herbarium specimens of Hudson and Turner in the British Museum, and much information about the algæ in question; also my father and brother for the time and trouble they took in obtaining some of the photographs reproduced.

Text-figures 3 & 4 are from drawings by Miss M. Green, the others by the author.



BROWN SEAWEEDS OF THE SALT MARSH.



Grout sc.

BROWN SEAWEEDS OF THE SALT MARSH.

EXPLANATION OF THE PLATES.

Plate 8.

Fig. 1. General view of part of the salt marshes at Blakeney Point, Norfolk, looking from the dunes in a southerly direction across the entrance to Blakeney Harbour. The flat in the middle of the picture, between the two shingle-banks, is mainly covered by *Pelvetia* in association with *Salicornia europea.* In the distance is seen the mainland between Morston and Sliffkey. The greater part of the picture is charted in text-fig. 1. (From a photograph by Prof. F. W. Oliver.)

Fig. 2. *Pelvetia* growing among *Salicornia europea.* About $\frac{1}{10}$ natural size. At *a* a characteristic piece of *Pelvetia* is visible. (From a photograph by Mr. E. J. Salisbury.)

Fig. 3. View of a stream in the marsh at Mersea Island, Essex, with *Fucus volubilis* plants along the banks. (From a photograph by Mr. G. S. Baker.)

Plate 9.

Fig. 4. Plant of *Fucus volubilis* growing on the mud at Mersea Island. About $\frac{1}{8}$ the natural size. (From a photograph by Mr. G. S. Baker.)

Fig. 5. Transverse section of a ♂ conceptacle of *F. volubilis.* × 54 diam. The ostiole has sprung open owing to the delicacy of the surrounding tissue.

Fig. 6. Transverse section of a ♀ conceptacle of *F. volubilis.* × 54 diam. Fig. 6 *a* shows an oogonium divided into three, in section; the other oogonia are undivided

Freshwater Algæ collected in the South Orkneys by Mr. R. N. Rudmose Brown, B.Sc., of the Scottish National Antarctic Expedition, 1902–04. By F. E. Fritsch, D.Sc., Ph.D., F.L.S., Professor of Botany, East London College, University of London.

(Plates 10 & 11 and 1 Text-figure.)

[Read 4th May, 1911.]

A. Introductory Remarks.

In the year 1905 I received from Mr. R. N. Rudmose Brown, B.Sc., seventeen tubes of freshwater and subaerial Algæ collected by him in the South Orkneys, while acting as botanist to the Scottish National Antarctic Expedition (1902–1904). I am glad to have this opportunity of thanking him for placing this interesting material at my disposal. The great delay in dealing with it has arisen partly out of the great difficulties in the way of certainly determining many of the forms present and partly out of preoccupation with other matters.

Our present knowledge of Antarctic freshwater Algæ is rather meagre. The first important contribution is that of Hooker and Harvey *, based on the material collected by the 'Erebus' and 'Terror' in 1839–43. This was followed about 35 years later by two papers of Reinsch †, containing a description of the Algæ collected by the Rev. A. E. Eaton on the island of Kerguelen. A later paper by Reinsch ‡ deals with the freshwater Algæ collected by Dr. H. Will in South Georgia. Since then Wille § has described a few forms brought by C. E. Borchgrevink from the Antarctic continent,

* J. D. Hooker, "The Botany of the Antarctic Voyage of H.M. Discovery Ships 'Erebus' and 'Terror' in the years 1839–43" (Flora Antarctica). Algæ (by W. H. Harvey and J. D. Hooker). Vol. i. pp. 175–193 [1845]; vol. ii. pp. 454–519 [1846–47].

† P. F. Reinsch, "Species ac Genera nova Algarum aquæ dulcis, quæ sunt inventa in speciminibus in expeditione Vener. transit. hieme 1874–75 in Insula Kerguelensi a clar. Eaton collectis," in Journ. Linn. Soc., Bot. 1876, xv. pp. 205–221; and "Freshwater Algæ collected by the Rev. A. E. Eaton. Algæ aquæ dulcis Insulæ Kerguelensis," in Phil. Trans. Roy. Soc. London, vol. 168, 1879, pp. 65–92. See also W. Archer, "Note on the Freshwater Algæ collected by H. N. Moseley in Kerguelen's Land," in Journ. Linn. Soc., Bot. 1876, xv. pp. 445–446; E. O'Meara, "On the Diatomaceous Gatherings made at Kerguelen's Land by H. N. Moseley, H.M.S. 'Challenger,' *loc. cit.* pp. 55–59.

‡ P. F. Reinsch, "Die Süsswasseralgenflora von Süd-Georgien," in G. Neumayer, 'Die deutschen Expeditionen und ihre Ergebnisse,' Bd. ii. 1890, pp. 329–365, tabb. 1–4.

§ N. Wille, "Mitteilungen über einige von C. E. Borchgrevink auf dem antarktischen Festlande gesammelte Pflanzen: III. Antarktische Algen (by N. Wille); IV. *Navicula mutica*, Kütz., aus dem antarktischen Festlande (by J. Holmboe)," in Nyt Mag. f. Naturvidenskab. xl. 1902, pp. 209–222, pls. 3–4.

and De Wildeman a number of Algæ collected by É. Racovitza, of the Belgian Antarctic Expedition *. A considerable number of papers on Antarctic Algæ deal solely with marine forms †.

The South Orkneys (lat. about 61° S.) are situated appreciably further south than either South Georgia (lat. about 55° S.) or Kerguelen (lat. about 49° S.), from which most of the previously described material has been derived. This may explain the marked difference in the character of the algal collections obtained from the South Orkneys as compared with those from the other two localities. In the material from the South Orkneys filamentous forms play a very insignificant part, and the bulk of the Algæ consists of unicellular and colonial species. The total number of species recorded from the South Orkneys in the present paper is sixty-eight (of these one genus and seven species are new). The table on p. 295 shows how the main groups are represented. This table, however, gives no idea of the relative part played by the different groups. As a matter of fact (apart from the abundant *Prasiola*), the lowly unicellular Isokontæ and Cyanophyceæ are the predominant features of the flora, the former being, on the whole, more abundant than the latter. In this connection we may notice, however, that the complete absence of common cosmopolitan forms like *Scenedesmus*, *Pediastrum*, *Cosmarium*, *Closterium*, etc. is very striking. The Œdogoniaceæ, as, indeed, all filamentous forms, are represented only by stray filaments. Only two filaments (one of *Mougeotia*, the other of *Zygnema*) of Zygnemaceæ were observed. The occurrence of filaments of the various genera nevertheless testifies to the fact that at certain periods their development must be more prominent. Desmids were represented only in two samples by three species. Diatoms are not common, and in some samples (*e. g.* yellow snow) were almost completely absent. Their determination was in many cases a matter of great difficulty, as frequently only dead fragments of the valves were to be found, and it is probable that a larger number of species actually occurs than is recorded in the present paper. In a number of the samples the unicellular algal flora occurred as a thin covering to numerous muddy particles, and it was necessary to crush the latter in order to find any appreciable number of algal forms.

The lowly unicellular and colonial forms of Algæ are well known to be in many cases among the most difficult forms to determine, and to add to this difficulty a very large proportion of the species in the South Orkneys material were in the resting-stage, or at least in a sufficiently dormant condition to fail to show more than one phase in the life-history. This is

* É. de Wildeman, "Note préliminaire sur les Algues rapportées par M. É. Racovitza, naturaliste de l'expédition antarctique belge," in Bull. Ac. Roy. de Belgique, 1900, pp. 558–569.

† I am indebted to Mr. & Mrs. A. Gepp and to Dr. B. D. Jackson for kind help in connection with the literature cited in the present paper.

particularly true of the forms found on the snow (yellow and red snow), but applies to a lesse extent to practically the whole of the material; only in one case (samples gathered on Feb. 4th, 1903, from a freshwater pond at an altitude of 140 feet between the peaks of Saddle Island, South Orkneys) were organisms (species of *Chlamydomonas*) present, which had evidently been preserved in an actively motile condition. For this reason it has seemed best to give as complete an account of the material as possible, in the hope that subsequent investigations may lead to a better interpretation of some of the forms observed. This has been carried out especially in the case of the yellow snow flora.

Some of the numerous resting-stages observed are referable to described species of the genus *Trochiscia*, or at least come very close to some of them; where this was the case, they have been enumerated under the genus *Trochiscia* (see the systematic part of the paper), although it was thought undesirable (except in one case) to establish new species on this basis. It can hardly be doubted that some of the species of *Trochiscia* are merely resting-stages of other Algæ, although where a definite course of reproduction has been observed we are probably dealing with independent forms. In the case of the material from the South Orkneys no evidence as to the authenticity of *Trochiscia*-forms was to be expected, since no single case of reproduction was observed; and there was no choice save to record the diverse structures noticed as species of this genus.

On the whole, it is astonishing that, considering the abundance of some of the algal forms, only very few reproductive stages were found; in some cases (*e. g.* the *Trochiscias* just referred to, *Chodatella brevispina*) not even an indication of division of the individuals was observed, although the material was collected during the milder portion of the year (October to March). The mean temperature, however, even at this period (as Mr. R. N. Rudmose Brown informs me) is only 32° F. It seems therefore as though many of these Antarctic forms reproduce only during very limited periods, when the conditions are especially favourable.

As above stated, the freshwater algal floras of Kerguelen and South Georgia, as described by Reinsch (*loc. cit.*), have a rather different character. The following table shows the relative composition of the algal floras of these two localities and of the South Orkneys:—

	Kerguelen.		South Georgia.		South Orkneys.	
	Genera.	*Species.*	*Genera.*	*Species.*	*Genera.*	*Species.*
Isokontæ (incl. Œdogoniaceæ)	25	36 (20 fil.)	17	32 (12 fil.)	17	29 (5 fil.)
Conjugatæ	8	12 (7 fil.)	5	20 (1 fil.)	4	5 (2 fil.)
Heterokontæ	..	..	1	1	1	1
Cyanophyceæ	18	33	5	5	13	18
Diatomaceæ	12	21	10	19	9	15
Phæo- and Rhodophyceæ	2	2	..	..	..	..
Totals	65	104	38	77	44	68

Both in Kerguelen and South Georgia the flora is richer in Conjugates, especially in Desmids, which are responsible for 19 of the 20 species from South Georgia, while in the vegetation of the latter the Cyanophyceæ play a comparatively small part. But it is in the relative number of filamentous forms (species of *Œdogonium, Bulbochæte, Ulothrix, Rhizoclonium, Vaucheria, Spirogyra*, etc.) present in the flora of Kerguelen and South Georgia as compared with the South Orkneys that the difference becomes most striking ; in this connection we may also notice that there is a considerable reduction in the number of filamentous forms from South Georgia as compared with Kerguelen. From both localities also reproductive material was obtained (*Vaucheria* from Kerguelen, *Vaucheria* and *Œdogonium* from South Georgia). Lastly, we may notice that the common cosmopolitan forms, whose absence from the flora of the South Orkneys was commented upon above, are all recorded by Reinsch from either Kerguelen or South Georgia. It is hardly likely that all these striking differences in the composition of the algal flora of the South Orkneys are purely accidental ; they are probably to be ascribed to the geographical position of the South Orkneys and the consequent severer climatic conditions.

To avoid frequent repetition, I append a list of the localities in which the different samples were collected ; the corresponding number will alone be referred to in the systematic portion of this paper :—

No. 1. Yellow snow. The Beach, Scotia Bay. 7.2.04.
" 2. " " " 27.3.03.
" 3. Same locality and date as No. 1.
" 4. Red Snow. Scotia Bay. 27.3.03.
" 5. " From ice-foot, head of Scotia Bay. 29.12.03.
" 6. Same locality as No. 5, but collected 1.1.04.
" 7. Algæ from germ-culture from surface water, 62° 52′ S., 25° 00′ W. 16.2.03 (Only Fungi present.)
" 8 & 9. Scrapings of rocks and mud from pools or streams. Mossy rocks, Scotia Bay 28.12.03.
" 10 & 11. Freshwater pond. 140 feet between peaks of Saddle Island, South Orkneys 4.2.03.
" 12. Rocks about tide-wash. Buchan Bay, South Orkneys. 25.3.03.
" 13. Mud and damp moss. Point Martin, Scotia Bay. 7.1.04.
" 14. Mud from penguin rookery. Point Martin, Scotia Bay. 26.10.03.
" 15. Freshwater pool. Point Thomsen, Brown's Bay. No date.
" 16. Stones on north of beach, Scotia Bay. 11.11.03.
" 17. Mud from moss on rocks at Point Martin, Scotia Bay. 21.10.03.

In the following pages the flora of the yellow and red snow is first dealt with separately, and this is followed by a systematic enumeration of all the species observed.

B. Yellow Snow. (*Cf.* Plates **10** and **11.**)

Three samples of this peculiar type of snow flora were included in the material from the South Orkneys: Nos. 1 and 3 were collected on the same date (Feb. 7th, 1904), and agreed almost completely with one another, while No. 2, which was collected about a year earlier (March 27th, 1903), was relatively poor in algal forms (perhaps owing to its being the end of the Antarctic summer), consisting largely of hairs and other foreign particles. Apart from this, however, such forms as were present were the same as those found in the other two samples. All three samples came from the same locality.

Samples 1 and 3 contained a considerable quantity of algal material and show that the yellow snow flora, when well developed, must form extensive masses. In reply to enquiries, Dr. R. N. Rudmose Brown has very kindly furnished me with the following particulars. I quote from his letters:—"Both red and yellow snow are rare at the South Orkneys, and many apparent cases of the latter which I examined were due only to penguin manure. The samples I sent you were taken towards the end of the summer on a snow-covered plain called the Beach, that was certainly often frequented by penguins, but did not contain a rookery. The samples were gathered on the surface of snow that had fallen some little time past—perhaps two or three days,—and whose surface had been slightly melted by the sun. I do not remember ever seeing any coloured snow in winter, but at that season snow was falling so continuously and drifting so incessantly that any growth would be immediately covered over. October to February is the warmest season, but the mean temperature even then is not above 32° F. . . . . The colour of the yellow snow is fairly bright. I do not remember any brown snow, nor have I any record of a green patch being mixed with a yellow one. The Algæ were on the surface and perhaps two or three or even four millimetres down mixed with the snow, but in sufficient abundance to give an unmistakable pale (bright yellow) patch. Yellow and red snow were quite distinct from one another; they may in places have been within 30 or 50 yards of one another, but this was not habitual, and I do not remember a single case of the two adjoining one another."

A considerable number of papers have been published dealing with the type of algal flora known as red snow *, which has been recorded from alpine (temperate and tropical), arctic, and antarctic localities. Brown and green snow have also been described both from alpine and arctic regions †, while

* See Section C of this paper; also J. Roy, "The Flora and Fauna of Snow and Ice," Scottish Naturalist, viii. 1885–86, pp. 122–127.

† Wittrock, V. B., "Om snöns och isens flora," in Nordenskiöld, 'Studier och Forskningar föranledda at mina resor i höga norden,' 1883, pp. 65–115; see also Wittrock, V. B., "Die

Rostafinski * has recorded yellowish snow (apparently due to a species of *Chlamydomonas*) on the snow-fields of the Carpathians. Chodat †, lastly, also refers to black snow (neige noir) and describes a yellowish-orange organism, *Pteromonas nivalis*, as occurring in it. All these different types of snow flora, however, appear to be very markedly distinct from the yellow snow collected in the Antarctic, and I have therefore thought it expedient to deal with this part of the South Orkneys material separately.

The organisms composing the yellow snow flora are in part similar to or identical with some of those found in red and other coloured snow, but there are a number of very distinct types (e. g. *Protoderma Brownii*, *Chlorosphæra antarctica*, *Scotiella antarctica*, and *Chodatella brevispina*) that give this association a characteristic stamp. There seems some probability that the yellow snow flora is an example of what I have called an algal consortium ‡, in which certain members first prepare a suitable substratum for the growth of the others ; but this could, of course, only be definitely settled by observations made on the spot. All the typical and common members of the yellow snow flora include a varying (but often very large) quantity of an apparently solid fat in their cell-contents, which appears in the form of large highly refractive lumps §. The amount of this fat is often so considerable that little can be seen of the remaining cell-contents, while in other cases, and often quite inexplicably, the fat is completely absent. It appears that the yellow pigment, which is the cause of the characteristic colour of the yellow snow, is included in this fat, although, as most of the pigment had been dissolved out by the preserving fluid, I cannot be certain with reference to this point. I have been unable to make out the nature of the pigment,

Flora des Schnees und des Eises besonders in den arktischen Gegenden," in Bot. Centralbl. xiv. 1883, p. 159; Warming, E., 'Œcology of Plants' (Engl. transl. by P. Groom), 1909, p. 163.

* Rostafinski, J., "Vorläufige Mitteilung über rothen und gelben Schnee und eine neue in der Tatra entdeckte Gruppe von braungefärbten Algen" (Polish), in Sitzungsber. d. Krak. Akad. d. Wissensch. mat.-nat. Sect. 1880; Abstract in Bot. Centralbl. viii. 1881, p. 225, and Just's Botan. Jahresber. 8 (1880), i. 1883, p. 564.

† R. Chodat, 'Algues vertes de la Suisse,' 1902, pp. 96 and 145–146; see also Brun, "Sur la neige noir," in 'Echo des Alpes,' 1845, p. 182.

‡ F. E. Fritsch, "Problems in Aquatic Biology," in 'New Phytologist,' vol. v. 1906, pp. 157–8.

§ These lumps gave all the characteristic fat-reactions (*cf.* Zimmermann, 'Die botan. Mikrotechnik,' 1892, pp. 68–71). Material treated with osmic acid acquires a very characteristic appearance; there is so much fat in the different forms that the whole mass becomes black to the naked eye, while material thus treated and mounted on a slide presents the appearance of numerous black dots when held up to the light. Under the microscope many of the cells appear stained a homogeneous black, while parts of other cells are quite uncoloured, owing to restriction of the fat to one or two points in the cell-contents.

owing to the small quantity that was available; a spectroscopic examination of the alcohol in which the one sample was preserved disclosed a marked absorption of the violet end of the spectrum, which would indicate that the pigment might be analogous to carotin or xanthophyll, but none of the other reactions characteristic of this substance were obtained. As regards the fat, neither in its general appearance under the microscope nor in its behaviour towards the various reagents used (*cf.* footnote § on p. 298) was there anything to indicate a difference between the kind of fat present in the various members of the yellow snow flora. The occurrence of the fat and the associated yellow pigment is therefore a very characteristic feature of this algal association.

The enormous prevalence of fat in the members of the yellow snow flora is probably to be regarded as an adaptation against the intense cold of the habitat. It has been shown that in a number of trees (birch, Conifers) growing in cold localities the starch is changed into fat in the autumn *; and in referring to this fact Warming † remarks: "This is probably of use, in that fatty oil in the form of emulsion prevents sub-cooling and increases the power of resistance to frost." This view is certainly much strengthened by the discovery of the yellow snow with its striking characteristic of fat-storage. A similar abundance of fat does not appear to have been recorded hitherto in any snow flora ‡. The fact that the few reproductive stages that were observed in the yellow snow material were generally quite deficient in fat also indicates that the latter possibly functions as a reserve to be utilised when outside conditions admit of cell-division or other methods of reproduction taking place.

Material of yellow snow, treated respectively with alcohol and ether for 2½ days, was scarcely affected by the alcohol, although much of the fat was dissolved out by the ether. Even material which had been left in absolute alcohol for over three months failed to show any marked reduction in the amount of fat, so that the fat is one which is insoluble in alcohol. In the case of the material placed in ether a macroscopic change was visible after a few hours; the algal mass no longer formed a sediment at the base of the tube as at first, but was separated from the base by a clear space, consisting of ether, in which large numbers of roundish fat-globules could be seen floating about under the microscope. The actual cells were very much poorer in fat, although by no means all of the latter could be removed except by very prolonged treatment with ether. The fat also took on the typical red stain with tincture of alkanna. On the other hand, even prolonged treatment (36 hours) with equal parts of concentrated caustic potash and ammonia solutions, although it made the fat more transparent, failed to bring about proper saponification.

* A. Fischer, "Beiträge zur Physiologie der Holzgewächse," in Pringsheim's Jahrb. xxii. 1891; O. G. Petersen, "Stivelsen hos vore Troer under Vinterhvilen," in Danske Vid. Selsk. Oversigt, 1896; *cf.* also Schimper, 'Plant-Geography' (Engl. transl.), 1903, p. 41.

† Warming, 'Œcology of Plants' (Engl. transl. by P. Groom), 1909, p. 23.

‡ *Ibid.* p. 163.

In most cases the organisms found on snow and ice contain some characteristic pigment (red hæmatochrome in the case of *Chlamydomonas nivalis*; violet or purple phycoporphyrin in the case of *Ancylonema Nordenskiöldii*), although green snow (due to filamentous Algæ, Desmids, and Cyanophyceæ) has also been described. Similar pigments are found in members of many other types of algal floras, but there is certainly a prevalence of pigmentation in forms occurring on the snow. It has been pointed out that these pigments are capable of absorbing the heat-rays of the sun *, and it is also possible that they may serve to screen the chlorophyll during the long summer †. It is difficult to express an opinion on the function of the yellow pigment colouring the organisms of the yellow snow, but it is possible that it acts in one or both of these ways. In support of this it is noticeable that the *Protoderma*, which presumably forms a sheet on which the other forms settle down, is on the whole very poor in fat and pigment, perhaps because it is screened by the overlying forms from the light.

We may next proceed to consider the various organisms that are distinguishable in the yellow snow flora. Apart from a number of resting-stages, which could not be determined, 18 species of Algæ and two Fungi are concerned in the production of this association. The Algæ observed are the following:—

Protoderma Brownii, F. E. Fritsch, n. sp. (p. 301).
Chlorosphæra antarctica, F. E. Fritsch, n. sp. (p. 302).
Scotiella antarctica, F. E. Fritsch, n. gen. et sp. (p. 304).
Scotiella polyptera, F. E. Fritsch, n. sp. (p. 308).
Pteromonas nivalis, Chod. (p. 309).
Chodatella brevispina, F. E. Fritsch, n. sp. (p. 311).
Oocystis lacustris, Chod., f. *nivalis*, F. E. Fritsch, n. f. (p. 313).
Sphærocystis Schroeteri, Chod., f. *nivalis*, F. E. Fritsch, n. f. (p. 314).
Trochiscia antarctica, F. E. Fritsch, n. sp. (p. 316).
Raphidonema nivale, Lagerh. (p. 317).
Raphidium pyrenogerum, Chod.? (p. 318).
Ulothrix subtilis, Kütz.
Œdogonium sp.
Pleurococcus vulgaris, Menegh.
Chlamydomonas caudata, Wille.
" sp.? (p. 318).
Mesotænium Endlicherianum, Naeg.
Nostoc minutissimum, Kütz.

A considerable number of these forms will be considered in detail in the following paragraphs.

* *Cf.* V. B. Wittrock, "Die Flora des Schnees und des Eises besonders in den arktischen Gegenden," in Bot. Centralbl. xiv. 1883, p. 159; Warming, *loc. cit.* p. 163.

† *Cf.* Chodat, 'Algues vertes de la Suisse,' 1902, p. 74. Hæmatochrome certainly acts as a screen to the chlorophyll in other Algæ (e. g. *Trentepohlia*), *cf.* Oltmanns, Morph. u. Biol. d. Algen, ii. 1905, p. 200.

(*a*) Protoderma Brownii, *F. E. Fritsch.* (Pl. **10**. fig. 1; Pl. **11**. phots. 1, 2, 3, 5, P.)

The main ground-mass is constituted by a form which I somewhat doubtfully refer to the genus *Protoderma* as a new species, *P. Brownii* (Pl. **10**. fig. 1). This Alga probably forms broad sheets of cells with an irregular margin spread out on the surface of the snow, and may possibly serve as a basis for the growth of some of the other forms (*cf.* p. 298). A rough examination discloses merely a number of more or less rounded green protoplasmic masses, regularly arranged with reference to one another and separated by marked colourless intervals. The latter are due to the cell-walls, which are markedly gelatinous; a careful examination (especially of material stained with gentian-violet or methylene blue) reveals the polygonal (sometimes rather rounded) network due to the middle lamellæ of the walls and the (occasionally stratified) mucilage, which intervenes between middle lamella and cell-contents. The middle lamellæ frequently exhibit a granular character. Where the cell-contents are not obscured by the above-mentioned fat (which was frequently quite wanting in the cells of the *Protoderma*, cf. p. 300), it is possible to make out a single chloroplast, which generally takes the form of a curved plate and may frequently be almost hemispherical. In preparations stained with gentian-violet a single pyrenoid was often to be distinguished in the chloroplast, while iodine generally showed the presence of a limited number of starch-grains in the cells. In rare cases, adjoining cells of relatively small size were separated by thin and delicate walls; such cells are no doubt daughter-cells produced by division prior to preservation of the material. These young daughter-cells nearly always contained fat. On the whole, however, the *Protoderma* seemed in as inactive a condition as the other constituents of this snow flora. The cells vary considerably in size, from 5–12 μ or even more, but small cells are the rule; in most places they form but a single layer, but where extensive patches of the *Protoderma* were observed they appeared to lie in two (or more?) layers above one another.—The remaining species of the genus *Protoderma* are characterised, according to recent descriptions *, by the thallus consisting of a central group of irregularly arranged cells, from which short filaments radiate out at the periphery. Of this feature *Protoderma Brownii* shows nothing, the edge of the thallus in all cases presenting just as irregular an arrangement of the cells as obtains in the middle. *P. Brownii* also differs from the other species of the genus in not being an

* G. S. West, 'The British Freshwater Algæ,' 1904, p. 204 and fig. 83 A–C; N. Wille, "Conjugatæ and Chlorophyceæ," in Engler and Prantl, Die natürl. Pflanzenfamilien, Nachtr. z. Teil I. Abt. 2 (1909) p. 89; *cf.* also Hansgirg, 'Prodromus d. Algenflora v. Böhmen,' i. (1886), p. 224.

epiphyte (*cf.*, however, p. 329). Rabenhorst's figure and description of *P. viride* *, however, give no indication of any regular arrangement of the cells; and the same is true of Migula's recent description, which even refers to the cells as being "ordnungslos" and "nicht in Reihen" †. The latter's description of *Protoderma* also recalls the Antarctic form, in that he speaks of the thallus as "schleimig." This character is also referred to in Hansgirg's description ‡, which further contains a statement (on p. 225) as to the occurrence of oil-drops in the cells. It will therefore be evident that all the characteristic features of *P. Brownii* have already been referred to in the descriptions of *P. viride*, and it may ultimately prove to be but a form of the latter. For the present, however, it seems best to keep it as a distinct species, characterised by the irregular arrangement of the cells, the mucilaginous and granular character of the walls, and the frequent presence of fat in the cell-contents §.

(*b*) CHLOROSPHÆRA ANTARCTICA, *F. E. Fritsch.* (Pl. **10.** figs. 2–6 & Pl. **11.** phots. 1, 3, 5, 6 C.)

The next most abundant form is a new species of *Chlorosphæra*, which may be called *C. antarctica*, n. sp. (Pl. **10.** figs. 2–6). This is found either in the form of large isolated cells (figs. 2, 6) or as groups of smaller cells, commonly in fours or sometimes larger numbers (Pl. **10.** fig. 3); the average diameter of the cells varies between 11 and 26 μ, although smaller and much larger cells were also observed. The cells are provided with a well-defined rather thick membrane, which, especially in the case of the isolated cells, is often surrounded by a wide spherical sheath of transparent mucilage (Pl. **11.** phots. 1–3), to the outer edge of which numerous small foreign particles were generally adhering (Pl. **10.** fig. 2). The isolated cells were mostly more or less spherical in shape, while those forming groups were somewhat angular, probably as a result of mutual pressure. In many cases an almost spherical chloroplast could be made out in the cells without much difficulty; this chloroplast is only interrupted on one side of the cell by a small circular aperture, through which a small round body (in all probability the pyrenoid) can be seen (Pl. **10.** fig. 2). Starch is mostly present in small quantities in the smaller cells, but is often scarcely to be found in the larger ones. On the other hand, large masses of the above-mentioned fat were nearly always

* L. Rabenhorst, 'Flora europæa algarum aquæ dulcis et submarinæ," iii. 1868, pp. 288 & 307.

† W. Migula, 'Kryptogamenflora von Deutschland, Deutsch-Österreich und der Schweiz,' ii. 1 Teil, 1907, p. 747; *cf.* also Wille, *loc. cit.* Teil I. Abt. 2, 1897, p. 78.

‡ "Meist schlüpferig," according to Hansgirg, *loc. cit.* p. 224.

§ A full diagnosis of *Protoderma Brownii* will be found on p. 328. It seems very probable that the form shown by Wittrock ("Om snöns och isens flora," *loc. cit.*) in his fig. 17, pl. 3, belongs to this species, although the cells are more regularly arranged than in my form.

present in both kinds of cells, although certainly more abundant in the larger ones (figs. 2, 4, 5, 6). In a few cases the fat was apparently diffused rather equally throughout the contents of the cells, but it mostly formed very characteristic highly refractive lumps at one or more points immediately beneath the cell-wall. Frequently it appears in the form of concavo-convex lumps on one side of the cell, the mass of fat fitting like a cap over the protoplasmic contents (figs. 2, 6); occasionally this cap may even grow out of all proportion and give rise to a huge bulging mass on one side of the cell, which thus acquires an unusual shape. More rarely the fat forms a complete sheath with a rather irregular inner boundary around the protoplasmic contents. Apart from the cases as yet described, in which the fat exhibits an obvious connection with the cell-contents, a number of cells were always to be found in which there were numerous rounded or oval lumps of fat completely segregated from the somewhat contracted protoplasm of the cell and lying in a more or less well-marked space between the latter and the cell-wall (figs. 4, 5). The cells concerned were always somewhat oval in shape and showed the pyrenoid and the characters of the chloroplast very prominently. In a few cases (fig. 5) two pyrenoids were visible through the drawn-out aperture in the chloroplast, and this seems to indicate that these oval cells were about to divide. On the whole, such cells contain a relatively smaller amount of fat than the ordinary spherical cells do, and it would thus appear as though this segregation and diminution in the amount of fat might precede cell-division. Some uncertainty, however, naturally attaches to this interpretation until the actual process of cell-division has been observed. The conclusion that the large spherical cells with their transparent mucilage-sheath and the groups of smaller cells belong to one and the same species may be challenged; but apart from the identical structure of the cell in the two cases, I have found practically all transitions between the two sizes, and I think there can be little doubt that they all belong to the same species.—The genus *Chlorosphæra* * is characterised by its chloroplast and the power of vegetative division (which distinguishes it from the allied genus *Chlorococcum*), and by reproducing by subdivision of the cell-contents to form zoospores †; the absence of the latter method of reproduction in *C. antarctica* is not astonishing in view of the dormant character of the whole of the yellow snow flora. The new species seems to come nearest to *C. angulosa* ‡, in which Artari states that reproduction principally takes place by vegetative

* *Chlorosphæra* is included by G. S. West (Brit. Freshwater Algæ, p. 202) and some other authorities in the genus *Pleurococcus*, which is not in agreement with the views of Klebs, Artari, Wille, Oltmanns, etc.

† Klebs, "Üb. d. Organisation einiger Flagellatengruppen, etc.," in Unters. Bot. Inst. 1881-85, p. 343; Artari, "Unters. üb. Entwickl. u. Syst. einiger Protococcoideen," Diss. 1892, p. 35.

‡ *Cf.* Artari, *loc. cit.* p. 36.

division; *C. antarctica*, however, differs in the often appreciably smaller size of the cells after division, in the mucilage-sheath around the larger cells, and in the faculty of storing up large quantities of fat *.

(*c*) Scotiella antarctica, *F. E. Fritsch*. (Pl. **10**. figs. 7–17; Pl. **11**. phots. 1, 4, 6, 8c.)

The two species so far considered are by far the most abundant forms in the yellow snow flora, and the remaining members, although many of them not uncommon, are quite subsidiary to them. Among the latter is a very striking unicellular organism, which I regard as the type of a new genus, *Scotiella* †. I have observed two species of this genus, one of which (*S. antarctica*) is very much commoner in the yellow snow than the other, of which, indeed, only very few individuals were seen. Specimens of *Scotiella antarctica* were always to be found to the number of several in every sample of yellow snow examined (*cf.* Pl. **11**. photographs 1 & 6). The most prominent feature of this organism lies in the possession of six longitudinal wing-like extensions (briefly referred to as the wings in the subsequent description) of the wall, which run in a perfectly straight manner from one end of the cell to the other (Pl. **10**. figs. 7–11). The six wings are placed at equal intervals round the circumference of the cell, so that they form angles of 60° with one another; this is very well seen in individuals viewed from the end (*i. e.* in optical section, fig. 11), which have a very characteristic stellate appearance. Ordinarily, however, the cells are seen from the side, their general shape being oval, while the wings appear as follows (figs. 7, 10, 12): two of them lie flat with reference to the substratum and present themselves as lateral extensions (fig. 7, *1* & *2*) of the body of the cell, each of them about one-half the width of the latter; two further wings (*i. e.* those projecting towards the observer, fig. 7, *3* & *4*) appear as arched lines running over the surface of the cell from one end to the other and most obvious at a high focus, whilst at a lower focus two other longitudinal arched lines (representing the pair of wings running on the under side of the cell) are visible ‡. In no case have I observed more or less than six wings. The actual behaviour of the wings at the two ends of the individual proved rather difficult to determine, but I think there can be no doubt that they run as follows:—It appears that one pair of opposite wings (which may be termed the principal wings) runs equatorially round

* Storage of fat is also found in *Pleurococcus rufescens*, which appears to be a species of *Chlorosphæra*. A full diagnosis of *Chlorosphæra antarctica* is given on p. 324–5.

† Named after the 'Scotia,' the vessel which conveyed the members of the Scottish National Antarctic Expedition.

‡ These wings are not shown in any of the figures representing side-views of the organism.

the oval cell as a uniform expansion of the body (*1* & *2* in figs. 7, 8, 9, & 11, p. w. in fig. 8), this expansion being rather wider at the sides than at the two ends of the cells. In the other two pairs of wings (lateral wings) the wings of each pair form an angle of 60° with one another and with the principal wings, these pairs being *3*, *4* and *5*, *6* in fig. 11 *. At the two ends of the cell the wings of each lateral pair become very slightly arched out and then dip in suddenly and meet together, so that a kind of apparent sinus is formed at the two ends on either side of the principal wings (*cf.* fig. 7, and especially figs. 8 & 9, which are oblique end-views of *S. antarctica* showing only the course of the wings ; see also Pl. **11.** phot. 4). The customary position of an individual of *S. antarctica* is with the principal wings parallel to the substratum, as shown in fig. 7 (also Pl. **11.** phot. 4) ; in this case, as the figure indicates, the two ends of the cell appear completely rounded. But not uncommonly individuals are to be found in which wings *3*, *6* or *4*, *5* are parallel to the substratum (*cf.* fig. 10), and in such cases there is a prominent papillose protrusion at each end of the cell, due to the fact that the principal wings project further at these ends than do the lateral wings; a glance at figs. 7 & 9 should make this quite clear. The wings themselves are solid extensions of the wall, into which the cell-cavity does not penetrate (*cf.* fig. 11) ; they are conical in section, being broadest where they arise from the main body of the cell and gradually narrowing down to a rounded edge (fig. 11). In the side-views of the cell a very faint stratification of the solid wings could occasionally be observed, especially in stained preparations. At the middle of its longitudinal course each wing is provided with a slight but perfectly distinct notch (Pl. **10.** figs. 7, 10, 12 ; Pl. **11.** phot. 4), which divides it into two symmetrical halves ; this is an absolutely constant feature. The wings are quite rigid and stand off stiffly and at right angles to the surface of the cell ; in a drop of water the cells can be made to roll over and over without any apparent bending of the wings taking place.

The cell-contents of *Scotiella antarctica* were very difficult to decipher. It has been impossible to make out any details as to the shape of the chloroplast, which, however, appears to be single. Staining with iodine or hæmatoxylin sometimes brings out a small round body (figs. 11 & 13), which may be either a nucleus or pyrenoid, probably the latter. As a general rule, very little or no starch was demonstrable in the cell-contents, although occasional cells contained quite a lot. The abundant presence of the yellowish-white fat in the contents makes them astonishingly similar to those of *Chlorosphæra antarctica*. As in the latter case, the distribution of the fat shows considerable diversity. The contents mostly occupied the whole body of the cell, and in such cases the granular protoplasm is found in the middle

* In an optical section, such as fig. 11, there is nothing to distinguish the different wings from one another, and the numbering is purely arbitrary for the purposes of description.

and a cap of fat at each end of the cell-cavity; commonly these two caps of fat are roughly equal in size and more or less concavo-convex in shape, the concave side having an irregular outline and being directed towards the granular protoplasm in the centre of the cell. In other individuals two additional lumps of fat on either side of the cell occurred together with the other two masses. In some individuals, finally, the whole of the protoplasm was obscured by the fat, such cells presenting an opaque yellowish-white and homogeneous appearance.

Owing to the very marked similarity of the cell-contents in *Scotiella antarctica* and *Chlorosphæra antarctica*, I was at one time inclined to regard the large isolated cells of the latter as resting-stages of the *Scotiella*. This view seemed to obtain additional support from the fact that now and again an individual of *S. antarctica* is to be found in which the contents appear rounded off (fig. 16) and look very similar to a large *Chlorosphæra*-cell (except for the absence of the mucilage-envelope). There is, however, a good deal that negatives such an assumption. In the first place, it would appear as though the *Scotiella* forms resting-cells of a rather different type (*cf.* fig. 15 and the subsequent description). There is further an absence of connecting-stages between the normal *Scotiella*-individual and the *Chlorosphæra*-cells (saving such a stage as is shown in fig. 16). And, lastly, the *Chlorosphæra*-cells, as above mentioned, are of very diverse dimensions, whereas the range of size of the *Scotiella*-individuals is small; and I have never met with any small enough to give rise to resting-cells of the dimensions found in the smaller *Chlorosphæra*-cells. The cells of the latter (even the largest) are, moreover, occasionally found in considerable masses (twenty to fifty or more), separated from one another only by their mucilage-envelopes, which then often become polygonal as a result of mutual pressure; this is much more like what we should expect in a *Chlorosphæra* than in resting-cells of a form like the *Scotiella*, occurring as it does as isolated individuals. My object in discussing this point in detail has been to avoid the immediate adoption of an assumption which at first sight seems very plausible. At the same time, I do not wish to deny that with only the present material available for investigation we cannot completely dismiss the possibility of certain of the larger *Chlorosphæra*-cells ultimately proving to belong to the life-cycle of *Scotiella antarctica* *; it does not, however, seem probable.

In the course of the previous paragraph reference was made to resting-cells of *Scotiella*, which appear to arise in the following way (Pl. **10**. figs. 12–15):—Rather rarely one finds individuals of this Alga in which the contents are markedly contracted or more or less rounded off (figs. 12, 13,

* If so, they might prove to be germination-stages of the resting-cells described in the next paragraph, but there is no evidence for this.

also 16); in such cases some or all of the wings appear irregularly folded and stratified, so that they no longer show up so markedly (*cf.* figs. 12 & 16). Various stages of this kind have been found, which seem to form a complete series connecting the normal *Scotiella*-individual with large thick-walled resting-cells (fig. 15), the general shape of which is rounded, while the membrane is double with a more or less undulated outer layer. The formation of these resting-cells (akinetes) appears to be initiated by a swelling-up of the wall of the individual and the rounding-off of its contents. As a result of the swelling of the wall the outline of the wings is obscured, while the wall becomes more or less rounded off around the contracted contents (*cf.* figs. 13, 14); at the same time a stratification shows itself in the swollen wall, which subsequently grows more strongly and markedly thickened (figs. 14, 15). The contents appear to undergo a gradual change during the formation of the resting-cells. At first (fig. 13), as in the ordinary individuals, we have a central mass of granular protoplasm with a cap of fat at either end; as the contents round off, however, this fat disappears (used in forming the thick wall?), and the mature resting-cell contains only granular protoplasm (fig. 15)—possibly with a certain amount of fat diffused through it. Resting-cells of the type just described are fairly common in parts of the yellow snow material, but I have not met with any structures which could be interpreted as germination-stages of these cells; their further fate must therefore at present remain an open question.

One other possible stage in the life-history of *Scotiella antarctica* has been observed (Pl. **10.** fig. 17). This consists of a delicate, more or less oval membrane surrounding four oblong individuals of irregular shape, in some of which a pyrenoid was discernible; the irregular shape is due to the formation of various outgrowths on the surface of each individual. I have rather tentatively regarded these four cells as *Scotiella*-cells in the making, the outgrowths which appear to be solid being interpreted as the developing wings. Only two such stages have been observed, and they were both in the same condition, so that future observations must show whether the above interpretation is correct. Certainly no great stretch of the imagination is necessary to derive an ordinary *Scotiella*-individual from the oblong cells seen in fig. 17. If these stages really belong to the *Scotiella*, we still require to know whether they represent the division of an ordinary individual or of a resting-cell.

We may next proceed to consider the systematic position of *Scotiella*. In view of our rather incomplete knowledge of the organism its affinities are not easy to determine, but I am inclined to regard it as a fairly close ally of the genus *Oocystis*, from which it differs chiefly in its characteristic wings and in the marked storage of fat. Should fig. 17 actually represent a reproductive stage of an ordinary individual of *Scotiella antarctica*, then the latter organism would reproduce in a very similar way to *Oocystis*. The cells

of the latter are described * as having one or more parietal chloroplasts with or without pyrenoids, so that the probable occurrence of a single chloroplast with a pyrenoid in the *Scotiella* does not speak against a relationship with *Oocystis*. The latter genus is included by Oltmanns † in his Scenedesmaceæ, while Wille * refers it to the Oocystaceæ ‡.

Before concluding the discussion of *Scotiella antarctica*, reference must be made to the fact that the resting-cells (fig. 15) above referred to this species show considerable resemblance to *Trochiscia insignis*, Hansg. (= *Acanthococcus plicatus*, Reinsch), and to *T. obtusa*, Hansg. (= *Acanthoccocus obtusa* Reinsch) §. In the former case the cells are much larger than the resting-stages ascribed to the *Scotiella*, but in the latter case the dimensions approximately agree. It would, however, be inadvisable at the present moment to attempt any further comparison between these forms.

(*d*) SCOTIELLA POLYPTERA, *F. E. Fritsch*. (Pl. **10**. figs. 18–21.)

The second species of *Scotiella*, *S. polyptera* ‖, was, as above stated, only rarely found in the yellow snow material, but rather more abundantly in samples 11 and 15, from which all the figures were drawn (Pl. **10**. figs. 18–21). The material of this species was, however, so scanty, and the state of preservation of the individuals so bad in most cases, that only a brief description can be given. The cells are oval and of considerably smaller dimensions than those of *Scotiella antarctica*; in place of the six wings of the latter the cells are provided with numerous longitudinal wings, which generally have a somewhat spiral trend (fig. 18, and especially figs. 19 & 21). The wings do not stand off from the body of the cell nearly so prominently as in *S. antarctica* (*cf.* especially fig. 20, which is an oblique end-view of the organism). Each of the wings is undulated (fig. 18), and this fact together with the large number of the wings makes the cells present a notched crenate outline from whatever point they are viewed (*cf.* figs. 20, 21). At the two ends of the cells the wings bend inwards and terminate in a shallow sinus (fig. 20; also 21 & 18). The wings are solid, as in the other species, and appear as flat crenations in optical section (fig. 20). As regards the contents of the cells of *S. polyptera*, in the few cases in which they could be made out at all there appeared to be a single chloroplast with a prominent pyrenoid (fig. 21); fat was not observed in the cell-contents of this species.

* *Cf.* Wille, in Engl. & Prantl, Nat. Pflanzenfam. Teil I. Abt. 2, p. 58.

† Oltmanns, 'Morph. u. Biol. d. Algen,' vol. i. 1904, pp. 183 *et seq.*

‡ A full diagnosis of the new genus and species with measurements will be found on pp. 326, 327.

§ *Cf.* Migula, 'Kryptogamenfl. v. Deutschland, Deutsch-Österreich u. d. Schweiz,' ii. 1, p. 634, and pl. 35 E. fig. 5, pl. 35 F. fig. 10.

‖ πολὺς, many; πτερὸν, a wing.

Only one case of possible reproduction was found (fig. 19); a cell of *S. polyptera*, in which the outline of the wings had become obscure (visible, however, as delicate spiral lines in the right-hand portion of fig. 19), contained a number of elongated protoplasmic masses, in one of which a pyrenoid was prominent. This stage is possibly to be interpreted as division of the contents of the individual to form a number of daughter-individuals; if this is so, it, of course, constitutes a marked analogy to the probable stage of *S. antarctica* shown in fig. 17. It may be added that the individuals of *S. polyptera* were not uncommonly found in groups of four or five, which would quite accord with their being formed by subdivision of a common mother-individual.

Scotiella polyptera is obviously of a more dubious character than *S. antarctica*. While some doubt may justly be felt as to its independence (for it might be the zygospore of some form? *), it is impossible to feel quite certain of its close affinity to *S. antarctica*, and further observations may warrant its removal from the genus *Scotiella*. In view of the bad definition of the wings in all the cells observed, I am inclined to think that no normal individuals of *S. polyptera* were present in my material, and that all the forms observed were either preparing for division or passing over into some resting-stage †.

(*e*) PTEROMONAS NIVALIS, *Chod.*

Another form, of which, however, only very occasional specimens were met with in the yellow snow material, is represented in figs. 22–24 and 31 of Pl. **10**. This is almost certainly Chodat's *Pteromonas nivalis* ‡. The individuals are of an elongated oval shape and provided with a number of wings, which are rather sinuous and have a more or less marked spiral course (figs. 22–24). The number of wings has been determined as eight in individuals seen from the side, although none were seen in optical section as Chodat figures them (his figs. 70 H & J). The behaviour of the wings at the two ends of the cells could not be exactly determined, but it would seem (fig. 23) as though they projected somewhat at these points so as to give rise occasionally to the appearance of a terminal papilla (*cf.* also Chodat's figs. 70 B, C, K); all the wings appear to run together to a common point. In the cell-contents an irregularly shaped, more or less central chloroplast with a

* I have not, however, met with anything to countenance this view. Lagerheim ("Schneeflora des Pichincha," in Ber. Deutsch. Bot. Ges. x. 1892, p. 529; also "Schneeflora in Luleå Lappmark," in Bot. Centralbl. xvi. no. 11, 1883) refers to oval cells (15 μ broad and 30 μ long) as occurring in red snow from Amsterdamö (Spitzbergen). These cells are described as having longitudinal ridges, and may possibly represent the same form as *S. polyptera* or a closely allied one. Lagerheim, however, regards these cells as probably being zygospores of *Chlamydomonas lateritia* (*cf.* footnote § on p. 310).

† A diagnosis of *Scotiella polyptera* is given on p. 327.

‡ Chodat, 'Algues vertes de la Suisse,' 1902, pp. 145–146.

pyrenoid was often visible, and a considerable amount of the characteristic fat was mostly present *. No reproductive or resting-stages were observed.

It seems to me that the reference of this species to the genus *Pteromonas* is in no way certain †. The genus includes a number of species, which are actively motile forms provided with two cilia. In the case of *P. nivalis*, however, no cilia have been recorded, nor was I able to make out any traces of them in the yellow snow specimens. Onthis point Chodat ('Algues vertes,' p. 146) remarks: "cellules parfois mobiles, ordinairement immobiles; cils inconnus." Wille ‡, in his later description of this species, does not refer to any movement, in fact he regards the winged cells as resting-stages (aplanospores), and looks upon certain cells ("spindelförmige, an dem einen Ende etwas abgestumpfte Zellen," p. 168), which he figures on pl. 3. fig. 46 (*cf.* Chodat's fig. 70 F), as zoospores of the *Pteromonas* which had come to rest; possibly my fig. 31 may correspond to these cells. In view of the fact, however, that neither Chodat nor Wille nor I have seen any trace of cilia on either type of cell, these interpretations appear somewhat forced. A much simpler view would be to regard the typical winged form (as shown in Chodat's figs. 70 A, B, C, and my figs. 22–24) as the normal motionless individual and the unwinged cells (Chodat's fig. 70 F, Wille's fig. 46, and my fig. 31) as young individuals, possibly formed by division of the contents of a mother-individual, and in which wings have yet to arise (*cf.* Chodat's fig. 70 N); the correctness of this view depends mainly on the nature of the movement observed by Chodat. If my interpretation of *Pteromonas nivalis* is correct, it is obviously out of place in the genus *Pteromonas* and must be referred to *Scotiella* as *S. nivalis* (Chod.), F. E. Fritsch. With the genus *Scotiella* it agrees in several respects, viz.: the single chloroplast with a pyrenoid; the wings (*cf.* especially the optical section shown in Chodat's fig. 70 J with my optical section of *Scotiella antarctica*, fig. 11); the behaviour of these wings at the two ends of the cell ("qui se prolongent vers les extrémités en arête saillante," according to Chodat, p. 146; "An beiden Enden des Zellinhalts finden sich Vorsprünge . . . . sicherlich nur dadurch entstanden, dass die Rippen der Membran etwas vorsprangen," according to Wille, pp. 169, 170; *cf.* also my fig. 23); and, lastly, the apparent formation of new individuals by subdivision of the cell-contents §.

* Chodat describes the cells of *Pteromonas nivalis* as "ordinairement remplie d'une huile jaune-dorée" (p. 146), which may well correspond to the yellow fat observed in the individuals of the yellow snow. Wille ("Algologische Notizen, XI.–XIV.," in Nyt Magazin f. Naturvidenskab. xli. 1903, p. 170), however, speaks of the contents of the cells being generally coloured almost quite red by hæmatochrome. This is interesting, as indicating that one and the same snow-form may exhibit different pigments in different localities.

† *Cf.* Wille, *loc. cit.* p. 171.

‡ *Loc. cit.*

§ Wille (*loc. cit.* p. 171) also suggests on the basis of his observations that it may become necessary to remove *Pteromonas nivalis* from the genus *Pteromonas*; this is based on his view that the ordinary winged cells are aplanospores (resting-cells), that reproduction is

(*f*) CHODATELLA BREVISPINA, *F. E. Fritsch.* (Pl. **10**. fig. 25, 26; Pl. **11**. phots. 3, 5, Ch.)

A very typical and rather abundant member * of the yellow snow flora is constituted by spiny ellipsoidal cells, which appear to belong to a new species of *Chodatella*, which may be styled *C. brevispina* (Pl. **10**. figs. 25, 26). The cells of this species are discoid and about 18 μ long and 12 μ broad, and are covered all over their surface with uniformly distributed spines. The latter are very short, and, as a general rule, do not project beyond the surface for a distance greater than twice the thickness of the wall; they are mostly rather delicate, but occasionally individuals bearing coarser spines were to be found. All the spines on a given cell are generally of about the same length, although sometimes slight differences are noticeable. The cell-membrane is colourless and consists of two well-marked portions—a dark-looking outer (probably cuticular) layer and an inner much lighter layer. There appears to be a single chloroplast, although I do not feel certain of this; a pyrenoid was not observed. Large quantities of fat are almost always present in these cells. In the majority of cases two more or less rounded masses are found, one at each end of the cell and separated by a central mass of granular protoplasm in which a considerable amount of starch frequently occurs (fig. 26). Often one of these two fat-masses is considerably larger than the other, and occasionally only one large mass is present at one end of the cell. In some individuals, lastly, the fat predominates to such an extent that only a small amount of granular protoplasm can be distinguished, all the remaining part of the contents being obscured by the accumulation of fat (fig. 25).

The greatest difficulty in the way of a satisfactory determination of this form as a species of *Chodatella* lies in the absence of all reproductive stages. In *Chodatella* † reproduction is effected by subdivision of the cell-contents to

effected by small fusiform zoospores, and on the possibility of the cells containing several chloroplasts without pyrenoids (see *loc. cit.* p. 169). It does not appear that the last of these observations is correct, the others have already been criticised above.

Wille suggests that the oval cells provided with longitudinal ridges, referred to by Lagerheim as having been found in red snow from Amsterdamö (Spitzbergen) (*cf.* footnote * on p. 311), were individuals of *Pteromonas nivalis*. As stated in the footnote on p. 311, I am of opinion that they may belong to the genus *Scotiella*, but it hardly seems likely that they represent *Pteromonas nivalis*. The rather vague description points more to a form like *Scotiella polyptera*.

Until we know more about the movement referred to by Chodat, it seems advisable to leave *Pteromonas nivalis* in its present genus.

* This form is much commoner than *Scotiella antarctica*, but, owing to its smaller size, not nearly so striking.

† E. Lemmermann, "Beitr. z. Kenntn. d. Planktonalgen, I.," in Hedwigia, xxxvii. 1898, p. 309; Chodat, 'Algues vertes de la Suisse,' 1902, p. 191.

form a number of new daughter-individuals, which often acquire the shape, spines, etc. characteristic of the mature form before leaving the mother-cell (autospore-development). The individuals of *Chodatella brevispina* were frequently found lying together in groups of four or more, and that may indicate formation from a common mother-individual, but no stages in the process were observed. In most other species of *Chodatella* the spines are very long, few in number, and mostly confined to the ends of the cell; but there are two species (viz. *C. echidna*, Chod., and especially *C. armata*, Lemm.) * in which the spines are more evenly distributed and also of approximately equal length. No other species of *Chodatella*, however, bears spines all over its surface. In all the described species the spines are very much longer than in the Antarctic form, and for this reason the specific name "*brevispina*" is proposed for the latter. In his description of *C. ciliata*, Lemm., Chodat † states that the cells are "souvent munies de quelques globules huileux polaires," so that the occurrence of fat has already been recorded in the genus. The species of *Chodatella*, lastly, have one (or more) chloroplasts with or without pyrenoids. On the whole, therefore, the Antarctic form fits fairly well into the genus *Chodatella*, and, owing to its numerous short spines and abundant storage of fat, is regarded as a distinct species ‡.

Before passing on to the consideration of other forms it may be well to point out that there is some resemblance between *Chodatella brevispina* and the aplanospores of *Chloromonas alpina* §, found by Wille in green snow in Norway. Wille himself ‖ refers to the resemblance of these aplanospores to *Lagerheimia* (a closely allied genus, regarded by many authorities as not generically distinct from *Chodatella*), but found transitions seeming to connect these structures with the ordinary motile cells of *Chloromonas alpina*. As regards the resemblance between *Chodatella brevispina* and these aplanospores (apart from similarity in shape and size) it is purely superficial, for the latter have coarse pointed spines attached to the cell-wall by a broad base; they contain many plano-convex chloroplasts and, although occurring in the same kind of habitat (on snow), appear to harbour no fat. If Wille's interpretation of these structures is correct, there is a possibility of the individuals of *Chodatella brevispina* being aplanospores of some allied form; inasmuch, however, as Wille's evidence for the connection of the spiny

* Chodat, 'Algues vertes de la Suisse,' 1902, p. 192; Migula, Kryptogamenfl. Deutschl. u d. Schweiz, ii. 1, p. 671, pl. 35 Q. fig. 6. As the Antarctic species is not a Plankton-organism like most other species of the genus, the relative shortness of the spines is comprehensible.

† *Loc. cit.* p. 192.

‡ A full diagnosis of *Chodatella brevispina* will be found on p. 326.

§ *Cf.* Wille, "Algologische Notizen, XI.," in Nyt Mag. f. Naturvidenskab. xli. 1903, p. 124 & pl. 3. figs. 32–33.

‖ *Loc. cit.* p. 124.

cells he describes with *Chloromonas alpina* is a little doubtful, it may be that the latter constitute a second species of *Chodatella* occurring in the snow flora.

(*g*) OOCYSTIS LACUSTRIS, *Chod.*, f. NIVALIS, *F. E. Fritsch.* (Pl. 10. figs. 27, 28.)

Side by side with *Chodatella brevispina,* but much rarer than the latter, there occurs another form, which shows many similarities (Pl. 10. figs. 27, 28). The cells are of the same general shape and the cell-contents are often quite identical, there being two terminal globules of fat with intermediate granular protoplasm (fig. 27) ; a pyrenoid could not be made out. These cells, however, differ from those of *Chodatella brevispina* in three prominent respects : they are always of smaller dimensions (length 13–15 μ), they have a perfectly smooth rather thin membrane devoid of spines, and the ends are commonly more or less pointed (fig. 27) and never rounded off to such a marked extent as is the case in *Chodatella brevispina* (*cp.* even fig. 28 with figs. 25, 26). Were it not for the difference of shape and the absence of all intermediate stages these cells might be regarded as young individuals of the *Chodatella*, but as it is this view is scarcely permissible. Similar cells, though somewhat larger, appear to have been observed by Lagerheim * in red snow from Mt. Pichincha in Ecuador ; he suggests that they may belong to some member of the Volvocineæ. It seems much more likely, however, that they represent a species of *Oocystis.* In one or two cases a considerable number (about 16) of these cells were observed lying within a common mucilaginous investment, which would point to some species like *Oocystis lacustris* or *O. glœocystiformis.* There are further resemblances to *O. lacustris* in the pointed shape of the cell, in the (probably?) single chloroplast, and in the occurrence of oil-drops in the latter species † ; also in the very feeble thickening of the ends of the cells of *O. lacustris* ‡, a feature which is much more pronounced in other species of the genus. For these reasons I am inclined to regard the cells shown in figs. 27 & 28 as merely a form (*nivalis*) of *Oocystis lacustris*, Chod., characterized by the prominent storage of fat § ; the cells which Lagerheim observed may possibly belong to the same species.

* Lagerheim, "Schneeflora des Pichincha," in Ber. Deutsch. Bot. Ges. x. 1892, p. 525, footnote [2].—"Zahlreiche ovale Zellen, 6–10 μ dick und 10–20 μ lang, welche grünen Inhalt und an den Enden je einen zuweilen röthlichen Oeltropfen führten. Sie lagen immer isoliert und konnten nicht zur Entwickelung gebracht werden."

† *Cf.* Chodat, "Études de Biologie lacustre, in Bull. Herbier Boissier, v. 1897, p. 296 ; also 'Algues vertes de la Suisse,' 1902, p. 190, fig. 105.

‡ Chodat's figures in most cases give very little indication of this thickening, which was not to be found in the Antarctic specimens. The latter may possibly have been relatively young individuals, a view which is supported by the thinness of the walls.

§ See also p. 326.

(*h*) Sphærocystis Schröteri, *Chod.*, f. nivalis, *F. E. Fritsch*. (Pl. 11. phot. 2, S.)

In sample No. 3 of the yellow snow an organism (text-fig., F & G, p. 323) was very abundant which seems to be referable to the genus *Sphærocystis* of Chodat *. This form consists of larger or smaller groups of round or oval cells (text-fig., F), green in colour and with granular contents, embedded in very soft mucilage, the outline of which is often irregular, but sometimes roughly circular (particularly in the case of the smaller colonies). The cells are separated by considerable intervals from one another, and mostly show a very uniform distribution (text-fig., F); the intervening mucilage is quite structureless and invisible. Each cell has a delicate bounding membrane of its own; the shape of the cells is mostly spherical, but sometimes slightly oval, and a kind of colourless beak is often to be seen on one side. In a few cases, especially after staining with iodine or gentian violet, it appeared as though there were a pair of short cilia arising from this beak and attached close together. All attempts to obtain clearer preparations were, however, unsuccessful, and the presence of cilia in the Antarctic form must therefore remain doubtful. I have been able to make out only very little of the cell-contents; a small round body (probably a pyrenoid) can generally be detected, and there was commonly a small colourless area beneath the beak at the front end of the cell, but the chloroplast could not be properly deciphered. The cell-contents frequently contain starch, but fat was generall completely absent in these colonies.—Apart from the normal colonies just described, two other kinds of colonies were observed. Firstly, such as showed many or all of the cells in process of bipartition; and, secondly, colonies in which most or all of the cells had their contents divided up into a considerable number of smaller cells (generally about eight). The latter have a very characteristic appearance (text-fig., G) and are, on the whole, commoner than the other two types. The small cells in these colonies are often distinctly ovoid and pointed at one end. They are generally more or less filled with the all-pervading fat, which appears to arise in the cells of the normal colony at the time of their division; for whereas the cells of the normal colony are, as above mentioned, quite devoid of fat, occasional colonies are to be found in which the cells contain considerable quantities of fat, and in these one or other of the cells are always in process of division.

The genus *Sphærocystis* was described by Chodat in 1897 (*cf.* footnote * on

* Chodat, "Etudes de Biologie lacustre," in Bull. Herbier Boissier, v. 1897, pp. 292–295, pl. 9; also 'Algues vertes de la Suisse,' 1902, pp. 114–115, fig. 53. According to G. S. West (Journ. Linn. Soc., Bot. xxxix. 1909, pp. 75, 76) *Sphærocystis Schröteri*, Chod., and *Tetraspora lacustris*, Lemm., are synonymous (*cf.* also Chodat, Alg. vertes, p. 115).

p. 314); subsequently Wille * endeavoured to identify *Sphærocystis Schroeteri* with *Glœococcus mucosus* †, a view that was opposed by Chodat in a later paper ‡, mainly on the grounds of the marked difference in size of the colonies in the two genera and the absence of cilia in his form. There seems, however, to be some evidence for the synonymy of the two genera, although the species are not necessarily identical; for the present they are probably best kept distinct. Chodat failed to observe the cilia on the cells embedded in mucilage, stating definitely "pas de pseudocils"; Wille does not say whether he observed them, although, as he makes no negative statement, it is to be presumed that he did §. Wille ‖ describes as especially characteristic a clear space having the shape of an inverted funnel ("verkehrt trichterförmiger Raum") at the front end of the cell. This, I believe, coincides with the colourless area beneath the beak in the cells of the yellow snow form, although my material was not sufficiently well preserved to enable me to make out its exact shape. Apart from this, however, the Antarctic form agrees also in other respects with the descriptions of A. Braun, Chodat, and Wille. Chodat's fig. 53 B ('Algues vertes de la Suisse') very much resembles the normal colonies above described, although all the cells are generally not so spherical as his figure shows them ¶. His fig. 53 D (*cf.* also Wille, in Engler-Prantl, *loc. cit.* fig. 5 D) shows a similar subdivision of the cell-contents into a number of small parts, as in text-fig., G, p. 323; in my material, however, the membrane of the mother-cell always remained intact till division was complete **, and the *Schizochlamys*-like stages figured and described by Chodat were not observed. The most noticeable points of difference between the yellow snow form and Braun's and Wille's *Glœococcus* lie in the size of the colonies and possibly in the length of the cilia, which are stated to be very long in the latter form, although those which I believe to have observed were invariably rather short.

There can be no doubt that the three types of colonies found in the yellow

* Wille, "Algologische Notizen, XII. Über *Glœococcus mucosus*, A. Br.," in Nyt Mag. f. Naturvid. xli. 1903, pp. 163–166.

† *Cf.* A. Braun, 'Betrachtungen über die Erscheinung der Verjüngung in der Natur,' 1851, p. 169 (Engl. transl. by A. Henfrey, 1853, p. 159); also A. Braun, "Über *Chytridium*, etc.," Abhandl. kgl. Ak. d. Wiss. Berlin, 1855, pl. v. figs. 5–20.

‡ "Quelques points de nomenclature algologique, 1. *Sphærocystis*, Chod., ou *Glœococcus*, A. Braun ?," in Bull. Herb. Boissier, 2e sér. iv. 1904, p. 233.

§ There is also no mention of the cilia in Wille's description of *Glœococcus* in Engler u. Prantl, Die natürl. Pflanzenfam. Nachtr. z. Teil I. Abt. 2 (1909), p. 18.

‖ Wille, *loc. cit.* p. 165. This space is here, probably as a result of a misprint, described as occurring in the back part of the cell ("im hinteren Teile der Zelle"); *cf.* however, fig. 5 A (p. 19) in Engler-Prantl, *loc. cit.*

¶ An oval cell is, however, shown in the lower part of the colony.

** In one or two cases the membrane of the mother-cell was pronouncedly thickened, appearing gelatinous and stratified.

snow material and above described belong to one and the same form, as numerous connecting-links were observed. Rather rarely isolated cells of the *Chlamydomonas*-type were met with in the material; some of these certainly belong to species of *Chlamydomonas* (*cf.* below), but others may well be single swarmers of the *Sphærocystis*-colonies. Occasionally one finds more or less rounded granular cells with a wide envelope of delicate mucilage around the very delicate cell-wall; these cells agree in all respects with those of a normal colony, and it seems very probable that such stages constitute the commencement of a new colony. I have, however, been unable to demonstrate cilia in these cells.

The chief differences between *Sphærocystis Schroeteri* and *Glœococcus mucosus* on the one hand and the yellow snow form on the other may be summarised as follows:—(1) The colonies of the latter are frequently rather more irregular in shape than those of the former; (2) the cilia, if present, are much shorter; (3) the cells are of somewhat smaller dimensions and more frequently oval in shape; (4) *Schizochlamys*-like stages have not been observed; (5) the storage of fat. As I cannot feel certain of the occurrence of cilia in the yellow snow form, it will be best referred for the present to *Sphærocystis Schroeteri* as a forma *nivalis* *. It is of considerable interest that so abundant a Plankton-form as *Sphærocystis* should form an important constituent of the yellow snow flora.

(*i*) Trochiscia antarctica, *F. E. Fritsch.* (Pl. **10**. fig. 30.)

I have already referred to the abundant occurrence of species of *Trochiscia* in the Antarctic material; one of them is characteristic for the yellow snow flora (Pl. **10**. fig. 30), although not particularly common. It consists of isolated spherical cells with a thick and rather gelatinous-looking wall, which is uniformly covered with small processes. The latter have typically the shape of truncated wedges with the truncated surface outermost, so that the cell presents the appearance of a cogged wheel. There is, however, considerable variety in the degree of differentiation of these processes, all transitions having been found from cells in which the processes are but feebly indicated (probably young daughter-cells?) to such as have very prominent processes; in the latter case they are often of slightly unequal length. The processes appear to be interconnected by a network of ridges. The cell-contents were always a little contracted; they appear granular and often show a well-marked central pyrenoid. Starch is always present, but fat is rare in this form, although now and again cells were found with quite a large quantity of it.

This species of *Trochiscia* appears to show some resemblance to *T. halophila*

* *Cf.* p. 324.

and *T. reticularis* *, but both these species have larger cells, and there are differences in the character of the membrane. The yellow snow form may provisionally be regarded as a distinct species, *T. antarctica*, characterized by the peculiarly shaped processes on the membrane, the thick walls, and the faculty of fat-storage †. Attention may, however, be drawn to the similarity between this form and the zygospores of two species of *Chlamydomonas*, viz. *C. nivalis* ‡ and *C. globulosa* §; especially in the latter case there is some considerable resemblance. The character of the contents of *Trochiscia antarctica* was, however, not at all like that of a zygospore, since as a general rule no great quantity of food-reserves were present, and nothing to indicate any relation to a species of *Chlamydomonas* was observed in the material. In fact, *T. antarctica* presents more the appearance of an independent Alga than many other species of the genus do.

(*j*) Raphidonema nivale, *Lagerh.* (Pl. **10.** figs. 32, 33.)

A not uncommon member of the yellow snow flora consists of short filaments of three or four (but occasionally many) cells running to a point at one or both ends (Pl. **10.** figs. 32, 33). The cells are provided with a very thin membrane and contain but a single chloroplast without a pyrenoid. The filaments were generally more or less curved (fig. 33), and when only one end was pointed the other was rounded off (fig. 32). These filaments are undoubtedly referable to Lagerheim's genus *Raphidonema* ‖. He observed vegetative reproduction of this form, the threads breaking into two halves, each of which has at first one pointed and one rounded end. The stage shown in my fig. 32 undoubtedly shows one of the products of such a division. Subsequently, according to Lagerheim, the round end grows into a new hair-like point. Most of the individuals found in the yellow snow were of narrower dimensions than Lagerheim's form, and the cells were rather longer (fig. 33); but filaments were found here and there quite agreeing with *Raphidonema nivale*, and there is no reason to regard the forms in the yellow snow as distinct from this species.

In his recent revision of the green Algæ, Wille ¶ includes Lagerheim's *Raphidonema* in the genus *Raphidium*, Kütz. (= *Ankistrodesmus*, Corda);

* Hansgirg, 'Prodromus d. Algenflora v. Böhmen,' ii., 1892, pp. 240, 241.

† A full diagnosis of *Trochiscia antarctica* will be found on p. 325.

‡ Wille, "Algol. Notizen, IX.–XIV.," in Nyt Mag. f. Naturvidenskab. xli. 1903, pl. 3. fig. 45.

§ *Cf.* Chodat, 'Algues vertes de la Suisse,' 1902, p. 132, fig. 60 D.

‖ Lagerheim, "Schneeflora des Pichincha," in Ber. Deut. Bot. Ges. x. 1892, p. 523 & pl. 28. figs. 15–21.

¶ Wille, in Engler-Prantl, Die natürl. Pflanzenfam. Nachtr. z. Teil I. Abt. 2, 1909, p. 68.

this is in agreement with Chodat's earlier views *. It seems a little questionable, however, whether this is really warranted. The typical species of the genus *Raphidium* are unicellular or colonial forms, in which reproduction is effected by transverse division of the contents (frequently into four), followed by elongation of the segments, so that they ultimately come to lie side by side as a number of daughter-individuals within the mother-cell (so-called autospore-development). This has not been observed in *Raphidonema nivale*. On the other hand, although septate *Raphidiums* have been described (e.g., *R. pyrenogerum* and *R. nivale* †), the breaking-up of the septate individual into two parts by fragmentation is not known for this genus. The resemblance of *Raphidonema* to *Raphidium* therefore appears to be purely superficial, and one must agree to Lagerheim's original view ‡ regarding the snow Alga as a member of the Ulotrichales, probably to be included in the Chætophoraceæ ; the peculiar method of vegetative reproduction may, however, indicate a relationship to *Stichococcus* §, and until more is known about *Raphidonema* its exact position must remain doubtful.

Very rarely forms were found of the type shown in Pl. **10.** fig. 34. This shows a single cell of the *Raphidium*-type (diam. 2 μ) with a prominent central pyrenoid. This is probably a species of *Raphidium*, possibly *R. pyrenogerum*, which is distinguished by having a pyrenoid, but Chodat's species appears to be much broader. I have seen too few individuals to be sure of the specific determination.

Filamentous forms are poorly represented in the yellow snow flora. The most abundant is *Ulothrix subtilis*, of which relatively short filaments were always to be found (Pl. **11.** phots. 1, 2, & 6) embedded among the numerous unicellular and colonial constituents. Next in abundance comes *Raphidonema nivale*, which has already been considered. Lastly, very occasional filaments of a broad species of *Œdogonium* (diam. cell = 20 μ) with well-marked caps were observed.

The remaining Algæ found in the yellow snow are very rare. These include forms like *Pleurococcus vulgaris*, Menegh., *Mesotænium Endlicherianum*, Naeg., *Chlamydomonas caudata*, Wille, *Nostoc minutissimum*, Kütz., and probably other species of *Chlamydomonas*. Lastly, mention must be made of large round cells with a smooth and fairly thick membrane and filled with yellowish-red or reddish, homogeneous or somewhat granular contents (text-fig., D, p. 323) ; the contents were commonly slightly contracted

* Chodat, "Flores des neiges du col des Ecandies," in Bull. Herb. Boissier, iv. 1896, p. 886. It does not seem that Chodat's *R. nivale* is in any way allied to *Raphidonema*.

† Chodat, 'Algues vertes de la Suisse,' 1902, p. 200, fig. 120.

‡ Ber. Deut. Bot. Ges. x. 1892, p. 523.

§ *Cf.* Lagerheim, *loc. cit.* pp. 523, 524.

away from the wall on one side of the cell. These cells are of large size (diam. = about 40–60 μ)—often as big or bigger than the largest *Chlorosphæra*-cells,—and although rare are very easily recognised when present, owing to their distinctive colour. These cells rather recall some figured by Wittrock * and referred by him to *Chlamydomonas nivalis*, Wille, but owing to their large size (about 52 μ) it may be doubtful whether they really belong to this species. Except for their larger size there is also some resemblance to the resting-cells of *C. sanguinea* †.

In sample No. 2 a fungus was frequently to be found which, judging by its gonidiophore, was a species of *Penicillium*. A second fungus occurred in the other two samples, but could not be determined ‡.

In concluding this consideration of the yellow snow flora, attention may be drawn to one or two general features. The flora is practically entirely composed of green Algæ (except for the above-mentioned species of *Nostoc*). Diatoms are represented only by fragments of frustules, and there are very few even of these. The Plankton character of the whole flora is also a point of interest, and indicates that it may have arisen in part by spores of Plankton-forms being carried by the wind on to the surface of the snow. This probably applies to all snow floras.

C. Red Snow §.

The three samples (Nos. 4–6) of red snow included in the collections from the South Orkneys were all of them very poor in algal forms, showing that

* V. B. Wittrock, "Om snöns och isens Flora, etc.," in A. E. Nordenskiöld, 'Studier och forskningar, etc.' (1883), pl. 3. fig. 2.

† Lagerheim, in Ber. Deut. Bot. Ges. x. 1892, pl. 28. fig. 1. It having been suggested to me that the cells above described might be cysts of Rotifers, I sent some material of yellow snow to Mr. James Murray, who very kindly informs me that the cells in question are quite unknown to him and not Rotifers. On the same authority I am able to state that the yellow snow includes yellow cysts (100–150 μ) of Bdelloid Rotifers and a species of *Collembola*.

‡ Tufts of short threads, richly branched in an arborescent manner and composed of spindle-shaped cells, 1 μ or less in diameter. Cells thickest at a point about two-thirds of their length from the base; from this point they taper gradually towards the base and rapidly towards the apex of each cell.

§ So many accounts of red snow have already been published that a general consideration seemed unnecessary, and the following account deals solely with the components of the samples of red snow from the South Orkneys. The most important contributions on the subject of red snow are:—V. B. Wittrock, "Om snöns och isens flora," etc., in Nordenskiöld, 'Studier och forskningar' (1883), pp. 65–123 & pl. 3; Lagerheim, "Bidrag till kännedomen om snöfloran i Luleå Lappmark," in Bot. Notiser, 1883; Lagerheim, "Die Schneeflora des Pichincha," in Ber. Deutsch. Bot. Ges. x. 1892, pp. 517–534, pl. 28; Lagerheim, "Ein Beitrag zur Schneeflora Spitzbergens," in Nuova Notarisia, 1894; Chodat, "Flore des neiges du col des Ecandies," in Bull. de l'Herb. Boiss. iv. 1896, pp. 881 *et seq.* & pl. 9; Chodat, 'Algues vertes de la Suisse,' 1902, pp. 95, 96.

red snow in this region does not attain to nearly so abundant a development as yellow snow *. The number of species present is also smaller. On the whole, sample 4 was richer in individuals than either 5 or 6 and showed a somewhat different constitution. Nearly all the forms present were in the resting-condition, so that some doubt attaches to certain determinations. The samples of red snow included a good deal of non-algal matter, such as hairs, starch-grains, pollen-grains of *Podocarpus*, etc.

In comparison with the flora of the yellow snow we have to note certain similarities and certain differences. Among the former we may reckon the occurrence of characteristic forms of the yellow snow flora, such as *Scotiella antarctica* and *Raphidonema nivale*. The former was found only in samples 5 and 6, especially in the latter; the number of individuals was small, but those present were of exceptionally large size (length of cell about 55 μ). They appeared to contain the same yellowish fat as in the yellow snow forms; no resting-stages were observed. The *Raphidonema* was quite common (especially in sample 4), and in this case agreed absolutely with Lagerheim's description. Apart from fragments of an *Œdogonium*, it was the only filamentous form present.

There are two marked differences from the yellow snow flora. These are (*a*) the immense preponderance of red spherical cells, no doubt constituting the resting-cells of different members of Chlamydomonadaceæ (see below), and (*b*) the occurrence of various Diatoms in all three samples. The resting-cells are of two chief types, viz. with and without a broad mucilage-sheath. The latter type are circular with a smooth, somewhat thickened membrane and granular contents with a central pyrenoid (text-fig., A, p. 323); the diameter of these cells varies between 10 and 20 μ. The red colouring-matter in the contents had been for the greater part taken up into the preserving fluid and the cell-contents appeared colourless or slightly greenish; it is therefore impossible to say what the exact colour of these cells was in nature. A considerable quantity of fat was often present in these resting-cells. They recall markedly the resting-cells (aplanospores) of *Chlamydomonas nivalis* (*Sphærella nivalis*, Sommerf.), as figured by Wittrock †. As very few other stages of this Alga were found, the determination must remain somewhat doubtful. In one or two cases subdivision of the contents into a number of parts was observed, but this, of course, scarcely aids in determining the species.

The second type of resting-cell (observed only in sample 4) closely resembles the other type except that the cells are surrounded by a broad sheath of mucilage about two to three times the width of the cell in diameter

* *Cf.* also the remarks on the distribution of red and yellow snow, cited on pp. 297 from Mr. (now Dr.) R. N. Rudmose Brown's letters.

† Wittrock, in Nordenskiöld, 'Studier och forskningar,' tab. 3. fig. 1.

(*cf.* text-fig., C *) ; in many cases the mucilage was of a deep red colour, probably owing to the colouring-matter of the cell having diffused out and stained the mucilage under the influence of the preserving fluid. This deeply coloured mucilage made details of the enclosed cell difficult to determine, but so much could be seen that it has a moderately thickened wall and granular contents ; a pyrenoid (?) was only very rarely visible. Numerous small particles were generally adhering to the surface of the mucilage, and this still further obscured the enclosed cell. The resting-cells of the second type were far less numerous than those of the first. They appear to correspond to cells observed by Lagerheim † and referred by him to *Chlamydomonas* sp. ; similar cells were noticed by Wittrock ‡. I am unable to add to our knowledge of these cells and have consequently merely described them in the systematic portion of this paper as *Chlamydomonas* sp. ? Inasmuch as these cells are of about the same dimensions as the smaller resting-cells of the first type (described above) and as the two kinds of cells occur side by side, they may be merely different stages of the same organism.

Apart from the forms hitherto mentioned, the only other constituents of the red snow from the South Orkneys are Diatoms, which are, however, found only as isolated individuals (*Melosira Sol*, Kütz., *Coscinodiscus radiatus*, Ehrenb., etc.). It seems probable that only the red resting-cells above described and the *Raphidonema* are true components of this flora, and that the remaining forms are introduced by the agency of wind and (?) animals (possibly the penguins). The *Scotiella* is perhaps an introduction from the yellow snow flora (which is not often very far separated from the red snow, *cf.* p. 298), while the Diatoms (which are in great part marine forms) probably come from the sea-shore.

The complete list of Algæ found in the red snow from the South Orkneys is as follows :—

Chlamydomonas nivalis (Sommerf.), Wille ?
Chlamydomonas sp. (*cf.* above).
Scotiella antarctica, F. E. Fritsch.
Raphidonema nivale, Lagerh.
Œdogonium sp.
Zygnema sp. (one filament).
Melosira Sol, Kütz.
Coscinodiscus radiatus, Ehrenb.
Navicula borealis (Ehrenb.), Kütz.
Amphora ovalis, Kütz.
Triceratium sp. (*T. arcticum*, Bright ?).

* The mucilage-sheath was often considerably broader than is shown in this figure.

† Lagerheim, Ber. Deutsch. Bot. Ges. x. 1892, pp. 523, 529, pl. 28. fig. 10.

‡ Wittrock, "Om snöns och isens Flora," *loc. cit.*

D. Systematic Enumeration of Freshwater Algæ from the South Orkneys.

ISOKONTÆ.

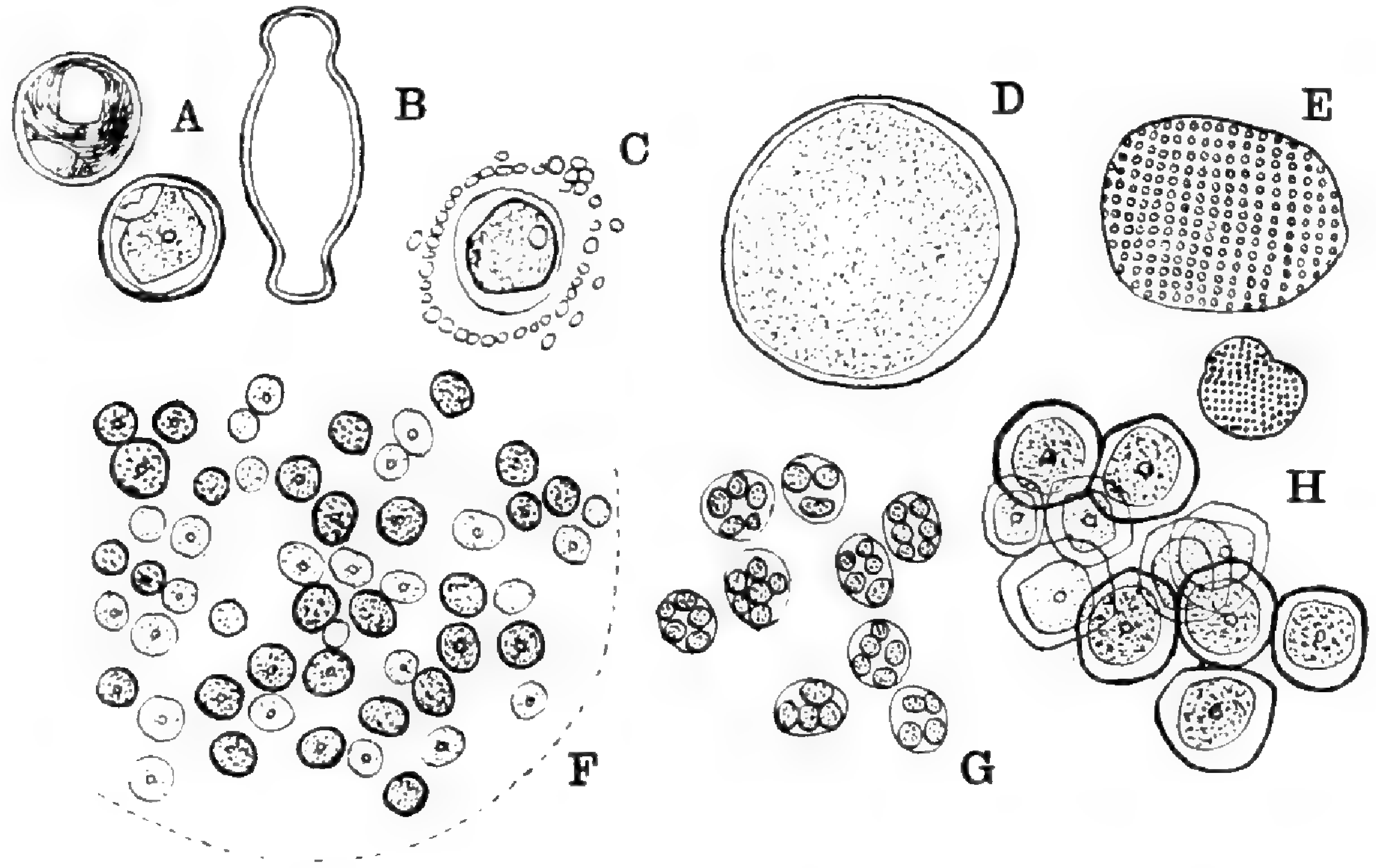
CHLAMYDOMONADACEÆ.

1. Chlamydomonas caudata, *Wille, Algol. Not.* xi. *in Nyt Mag. f. Naturvidenskab*, xli. 1903, pp. 115–118 & 135–136, pl. 3. figs. 4–11. (Pl. **10**. figs. 35–40.)

Samples 10 and 11, abundant; also as a rare form in the yellow snow.

This and the following species are the only forms found in the South Orkneys that were obviously preserved in an active motile condition. The prominent features of this species, as described by Wille, are the protrusion of the posterior end of the individual into a conical tip (figs. 37, 38), which is often somewhat bent to one side (fig. 36), the fact that the two cilia are about equal in length to the body of the cell and that the strongly thickened base of the chloroplast contains a median rounded pyrenoid (figs. 37, 38). There can be no doubt that the individuals observed belong to this species, although one or two minor points of difference were noted. The cilia were frequently found to be as much as $1\frac{1}{3}$ times the length of the cell (not shown in the figures); they were nearly always curved back or spread out at right angles to the body of the cell (figs. 37, 38), as Wille shows them. The size of the ordinary individuals varies considerably; length = 13–20 μ, breadth = 7–10 μ, but some of the dividing individuals are much larger. The pointed posterior end, as a general rule, lies in the same straight line as the axis of the individual, but bending was not uncommon. The cell-membrane is almost invariably much more prominently thickened at the pointed posterior end, and not uncommonly individuals are found in which the whole of the pointed portion consists of solid membrane (fig. 39). In many cases (*cf.* Wille, *loc. cit.*) the posterior part of the protoplasmic contents is also pointed and in the living individual probably in direct contact with the pointed cell-wall, although in preserved material generally separated from it by a space (*cf.* however, fig. 38). In a good many individuals, however, the back end of the protoplasmic body was rounded off and separated by a considerable interval from the pointed tip; it seems that this may be a preliminary to cell-division, as all dividing individuals were found to have the protoplast rounded off in this way (*cf.* fig. 35). Many examples of division (from the presence of two pyrenoids in the cell up to the formation of two daughter-individuals, fig. 35) were observed; in all cases such divisions were longitudinal and took place after withdrawal of the cilia. Very curious division-stages were found in the form of very large individuals (in this case

with or without cilia) containing a considerable number (eight or more) of protoplasmic units, each with a pyrenoid (fig. 36); such individuals may possibly have been forming gametes. The prominent beak at the point of origin of the cilia, described and figured by Wille, was often difficult to recognize. On the other hand, in a few cases there was a very pronounced



A. *Chlamydomonas nivalis* (Sommerfelt), Wille, resting-cells from the red snow (×900). **B**. *Navicula muticopsis*, Van Heurck, outline of an individual from sample 11 to show shape (×860). **C**. *Chlamydomonas* sp., resting-cells from the red snow (*cf.* pp. 321, 324) (×900). **D**. Resting-cells from the yellow snow (*cf.* p. 318) (×700). **E**. *Microcystis merismopedioides*, F. E. Fritsch (*cf.* p. 332): upper figure, surface-view of colony (×900); lower figure, typical colony of the same (×450). **F**. *Sphærocystis Schröteri*, Chod., f. *nivalis*, n. f., from the yellow snow (×450). **G**. The same, showing division of cells of colony (×700). **H**. *Cœlastrum microporum*, Näg., f. *irreguiare*, F. E. Fritsch (*cf.* p. 328) (×900).

development of this beak (fig. 40) in the form of a rounded protrusion, from the base of which the cilia arose. Apart from these peculiarities the Antarctic form showed all the features described by Wille, viz. ribbing of the basin-shaped choroplast, an elongated stigma (rarely visible), contractile vacuoles, etc.

2. Chlamydomonas Ehrenbergii, *Gorosch. in Bull. Soc. imp. d. Nat. de Moscou*, 1890, no. 3, pp. 128–131, pl. 3. figs. 10–25.

Samples 10 and 11, common.

Probable zygospores observed in sample 11.

3. ? CHLAMYDOMONAS INTERMEDIA, *Chod. Alg. Suisse*, 1902, p. 135.

Samples 10 and 11, rather common.

I am somewhat doubtful about the determination of this form.

4. CHLAMYDOMONAS NIVALIS (*Sommerf.*), *Wille*, *Algol. Notizen*, xi. *in Nyt Mag. f. Naturvidenskab.* xli. 1903, pp. 147–148.

Samples 4–6 (red snow !), common.

Text-fig., A, p. 323. *Cf.* description on p. 320; as suggested by Chodat, Wille, etc., these resting-cells may include Lagerheim's *C. sanguinea*. Diam. of resting-cells = 10–20 μ.

5. CHLAMYDOMONAS sp. (Text-fig., C.)

Sample 4 (red snow !), rather common.

Resting-cells in a wide sheath of mucilage; diam. of cell alone = 9–10 μ; of cell + mucilage = 20–28 μ (see also p. 321).

PHACOTACEÆ.

6. PTEROMONAS NIVALIS (*Shuttelw.*), *Chod. Alg. Suisse*, 1902, p. 145, fig. 70; *Wille, Alg. Not.* xiii. *in Nyt Mag. f. Naturv.* xli. 1903, pp. 167–171, pl. 3. figs. 46–51. (Pl. **10.** figs. 22–24 & 31; see pp. 310–311.)

Samples 1–3 (yellow snow !), isolated.

This species should probably be transferred to the genus *Scotiella* (*cf.* p. 310).

Length of individuals = 22 μ; breadth = 12 μ.

TETRASPORACEÆ.

7. SPHÆROCYSTIS SCHROETERI, *Chod. in Bull. Herb. Boissier*, v. 1897, p. 296, pl. 9, forma NIVALIS, *F. E. Fritsch.*

Familiæ microscopicæ forma paulo irregulariore quam in specie typica; cellulæ ante divisionem reservant abundantiam adipis, qui invenitur in cellulis filialibus; cellulæ sunt sæpe ellipsoideæ. Diam. cell. = 7–12 μ; diam. cell. fil. = 2–3 μ. (Text-fig., F–G; Pl. **11.** phot. 2, S; *cf.* pp. 314–316.)

Samples 1 and 3, especially common in the latter.

PROTOCOCCACEÆ.

8. CHLOROSPHÆRA ANTARCTICA, *F. E. Fritsch.* (Pl. **10.** figs. 2–6; Pl. **11.** phots. 1, 3, 5, 6, C.)

Cellulæ aut magnæ sphæricæ singulæ aut parvæ, paulum angulares in familias parvas consociatæ; cellulæ magnæ et interdum cellulæ parvæ vagina mucosa ampla munitæ; membrana modice incrassata, plerumque præbentes duo strata; chromatophora fere sphærica cum foramine parvo in una parte;

adeps semper adest abundans in cellulis; paucæ granulæ amylaceæ plerumque adsunt. Propagatio per divisionem; zoosporas non inveni.

Diam. max. cellulæ magnæ $=43\,\mu$; diam. min. cell. parvæ $=7\,\mu$ (omnes transitiones inter duas dimensiones); diam. cell. plerumque $=11$–$26\,\mu$; diam. vaginæ mucosæ $=39$–$50\,\mu$ (cell. pertinentes $=26$–$28\,\mu$).

Probably nearly allied to *C. angulosa,* Klebs (*cf.* p. 303).

Samples 1–3 (yellow snow!), very abundant.

For full consideration, see pp. 302–304.

9. TROCHISCIA HYSTRIX (*Reinsch*), *Hansg. in Hedwigia*, xxvii. 1888, p. 129; *Reinsch, Ueber* Acanthococcus, *in Ber. Deutsch. Bot. Ges.* iv. 1886, p. 241, t. 11. fig. 25.

Sample 10, rare; previously recorded from South Georgia (*Reinsch*).

10. TROCHISCIA RETICULARIS (*Reinsch*), *Hansg. Prodr. Algenflora v. Böhmen*, ii. 1892, p. 241. (Diam. cell. $=10\,\mu$.)

Sample 10, rather common.

A small form of this species.

11. TROCHISCIA ANTARCTICA, *F. E. Fritsch.*

Cellulæ sphæricæ solitariæ cum membrana crassa gelatinosa numerosis processibus cuneatis truncatis obtectæ et junctis reticulo costarum; chromatophoræ?; cellulæ cum cytioplasmate granuloso, semper granulas amylaceas et interdum aliquantum adipis includente. Propagatio?

Diam. cell. $=10$–$13\,\mu$; crassitudo membranæ $=2$–$3\,\mu$.

Probably allied to *T. reticularis* (Reinsch), Hansg.

Samples 1–3 (yellow snow!), fairly common.

For full consideration, see pp. 316–317.

12. TROCHISCIA NIVALIS, *Lagerh. in Ber. Deutsch. Bot. Ges.* x. 1892, p. 530 & pl. 28. fig. 23. (Pl. **10**. fig. 29.)

Sample 11, rare.

The individuals were rather smaller than those described by Lagerheim (diam. cell. $=10\,\mu$), but, as in his form, covered with very numerous minute spines; one (or more?) pyrenoids were visible in every case. There appear to be several chloroplasts.

13. TROCHISCIA PACHYDERMA (*Reinsch*), *Hansg. in Hedwigia*, xxvii. 1888, p. 128; *Reinsch, Ueber* Acanthococcus, *in Ber. Deutsch. Bot. Ges.* iv. 1886, p. 240, t. 11. figs. 8–9.

Samples 10 and 11, fairly common.

SCENEDESMACEÆ (sensu Oltmanns).

14. Oocystis lacustris, *Chod. in Bull. Herb. Boissier*, v. 1897, p. 296 & pl. 10. figs. 1–7, forma nivalis, *F. E. Fritsch.* (Pl. **10**. figs. 27, 28.)

Poli cellularum rotundati vel acuti ; in cellula aliquantum adipis flavi. Long. cell. =13–15 μ ; lat. cell. =9–10 μ.

Samples 1-3 (yellow snow !), rare.

This form has been fully considered on p. 313.

15. Oocystis solitaria, *Wittr. in Wittrock et Nordstedt, Alg. aquæ dulc. exsicc.* no. 244, *Bot. Notiser,* 1879, p. 24 & fig.

Sample 11, rare.

Cells ellipsoidal in shape with rounded ends ; membrane moderately thick, with apparently two layers, slightly thicker at the two ends of the cell ; cells generally solitary, but now and again to the number of about eight within a mother-cell. Fat generally present in the cell-contents ; length of cells =16–20 μ ; width =13 μ.

16. Chodatella brevispina, *F. E. Fritsch.* (Pl. **10**. figs. 25, 26 ; Pl. **11**. phots. 3, 5.)

Cellulæ ellipsoideæ plus minusve complanatæ setis brevibus quæ non amplius bis crassitudine membranæ cellulæ exstant per totam superficiem externam confertæ ; setæ plerumque tenues et angustæ, interdum paulo crassiores, æquilongæ ; inter ea quæ cellula continet semper est adeps, plerumque abundans, sæpe similis duobus globis in utroque fine cellulæ.

Long. cell. =17–20 μ ; lat. cell. =10–15 μ.

Differs from all hitherto described species of *Chodatella* in having very short spines, which cover the surface uniformly.

Samples 1 and 3 (yellow snow !), common ; isolated in sample 10.

A full consideration of this species will be found on pp. 311–313.

Scotiella, *F. E. Fritsch.*

Cellulæ ellipsoideæ in utroque fine rotundatæ processibus alæformibus plus minusve longitudinalibus sex aut multis munitæ ; alæ sunt aut rectæ aut undulatæ ; chromatophoram singularem esse probabile est, cum pyrenoide ; abundantia est adipis in una specie. Propagatio subdivisione cellulæ immutatæ aut sporæ perdurantis in paucas partes verisimile est. Sporæ perdurantes cum membranis valde incrassatis transfiguratione cellularum vulgarium formari videntur.

This genus is certainly a close ally of *Oocystis* (cf. p. 307). I think it very probable that *Pteromonas nivalis* (Shuttlw.), Chodat, is a species of this genus (*cf.* p. 310).

17. Scotiella antarctica, *F. E. Fritsch.* (Pl. **10.** figs. 7–17; Pl. **11.** phots. 1, 4, 6.)

Cellulæ ellipsoideæ circiter duplo longiores quam sunt latæ sex e pariete exstantibus alæformibus processibus, qui extenduntur recti et æquidistantes inter duos fines cellulæ instructæ. Unus par alarum oppositarum (alæ principales) extenditur continuus circa cellulam; duo alii pares alarum (alæ laterales) separati sunt alis principalibus, et ab utroque fine cellulæ paulum exstantes introrsum subito curvantur, ita ut in utroque fine cellulæ sinus formatus esse videatur (*cf.* fig. 8 et 9). Ala quæque habet mediam incisuram propriam speciei. Cellula continet multum adipis flaventis; cytioplasmatis structura investigari non potest. Sporæ perdurantes cum membrana crassa et undulata sunt formatæ metamorphosi cellularum vulgarium. Propagatio (?) subdivisione cellulæ immutatæ aut sporæ perdurantis in paucas partes possibile videtur.

Long. cell. ab altero fine ad alterum $=43–49\,\mu$ (interdum $55\,\mu$); lat. veri corporis cell. $=16–21\,\mu$; lat. totius cell. (*i. e.* cum alis) $=28–30\,\mu$ (interdum $42\,\mu$).

Samples 1–3 (yellow snow!), 5 and 6 (red snow!), 9, 11, and 15; rather common in yellow and red snow, rare in the other samples. Largest individuals in red snow.

A full description and consideration of this species will be found on pp. 304–308.

18. Scotiella polyptera, *F. E. Fritsch.* (Pl. **10.** figs. 18–21.)

Cellulæ late ellipsoideæ, paulo longiores quam sunt latæ, magno numero alarum multo minus exstantium quam in *S. antarctica* instructæ. Alæ plerumque sunt paulum directæ in spiram et undulatæ, ita ut adumbratio cellulæ videatur crenata ab omnibus partibus. Alæ exstant paulum ab utroque fine cellulæ et curvantur introrsum ita ut sinus debilis formetur. Adeps reservari non videtur. Sporæ perdurantes? Propagatio subdivisione cellularum vulgarium probabilis est.

Long. cell. $=20–24\,\mu$; lat. cell. $=16–17\,\mu$.

Samples 1 and 3 (yellow snow!), very rare; as an occasional form in samples 10, 11, and 15.

This species has been considered more fully on pp. 308–309.

19. ? Raphidium pyrenogerum, *Chod. Algues vertes de la Suisse*, 1902, p. 200, fig. 119. (Pl. **10.** fig. 34.)

Samples 1 and 3 (yellow snow!), rare.

Cf. p. 318. The forms observed are possibly referable to a distinct species, but the material was insufficient to come to definite conclusions on this point. Width of cells $=2\,\mu$.

20. Cœlastrum microporum, *Näg. ex A. Br. Alg. unicell.* 1855, p. 70; *Rabenh. Fl. Europ. Alg.* iii. 1868, p. 80.

Samples 10, 11, 15; fairly common.

20 *a*. Cœlastrum microporum, *Näg.*, forma irregulare, *F. E. Fritsch.* (Text-fig., H, p. 323.)

Cellulæ cœnobii irregularissime cohærentes.

In sample no. 11 there occurred side by side with normal colonies of *C. microporum* others in which the cells were very irregularly connected, so that the compact spherical appearance of the normal colony was often quite lost. Frequently the sphere was only half formed; in other cases, while several cells of the colony showed the usual arrangement, others were so arranged that they stood off from the general surface of the colony and completely destroyed the symmetrical character of the latter (text-fig., H). In other cases, again, the colonies were very small, consisting of only 4 or 6 cells. These peculiar forms may possibly be explained by Senn's observations ("Ueber einige coloniebildende einzellige Algen," Bot. Zeitung, lvii. 1899), who found that colonies of *Cœlastrum* tend to dissociate into their individual cells if plenty of oxygen is present in the surrounding medium. This is likely to be the case in water in these Antarctic localities and may account for the numerous irregularities above described. Samples 10, 11, and 14 contained numerous isolated cells of the *Cœlastrum*-type, and these are very probably to be regarded as dissociation-products of normal colonies.

21. Cœlastrum sphæricum, *Naeg. Gatt. einzell. Algen, Zürich*, 1849, p. 98 & tab. 5 c. fig. 1.

Sample 11, rather rare.

PLEUROCOCCACEÆ.

22. Pleurococcus vulgaris, *Menegh. Monograph. Nostoch.* p. 38.

Samples 1 and 3 (yellow snow!), rare; samples 10 and 11, not uncommon. This species was occasionally found in nos. 10 and 11 forming short filaments.

23. Protoderma Brownii, *F. E. Fritsch.* (Pl. **10**. fig. 1; Pl. **11**. phots. 1, 2, 3, 5, *P*.)

Thallus constat ex uno vel duobus (vel pluribus?) stratis cellularum et explanatus est in summa nive; margo thalli irregularis. Cellulæ multangulares vel angulis modice rotundatis; membranæ cellularum gelatinosæ (?), hyalinæ, lamellosæ, lamella intermedia paulum granulata. Chromatophora singula, similis disco arcuato, cum pyrenoide. Cellulæ interdum continent aliquantum adipis. Propagatio?

Diam. of cells = 5–12 μ.

Samples 1 and 3 (yellow snow !), abundant.

It is probable that *Pleurococcus vulgaris*, Menegh. β *cohærens*, Wittr. ("Om snöns och isens flora," *loc. cit.*), in part belongs to this species. Wittrock's fig. 17 (on pl. 3) strongly recalls a patch of *Protoderma Brownii.*

A full consideration of this species will be found on pp. 301–302. In sample 16 a very similar form was found growing on *Prasiola crispa* ; the cells (diam. 5–7 μ), however, lacked fat, and the cell-walls were not nearly so gelatinous.

24. Eremosphæra viridis, *De Bary, Conj.* p. 56, t. viii. figs. 26–27 ; *Rabenhorst, Fl. Europ. Alg.* iii. 1868, p. 24.

Sample 11.

Average diameter of cells =50 μ.

ULOTRICHACEÆ.

25. Ulothrix subtilis, *Kütz. Spec. Alg.* p. 345 ; *Tab. Phyc.* ii. t. 85 ; *Rabenhorst, Fl. Europ. Alg.* iii. 1868, p. 365.

Samples 1 and 3 (yellow snow !), rather rare.

CHÆTOPHORACEÆ.

26. Raphidonema nivale, *Lagerh. in Ber. Deutsch. Bot. Ges.* x. 1892, p. 523, pl. 28. figs. 15–21. (Pl. **10**. figs. 32, 33.)

Samples 1–3 (yellow snow !), rather rare ; 4–6 (red snow !), rather common.

Many of the filaments were narrower than Lagerheim's form ; diam. of cells =2–4 μ. See also pp. 317, 318, and 320.

ŒDOGONIACEÆ.

27. Œdogonium sp.

Samples 1 and 3 (yellow snow !), isolated.

Diam. of cells =20 μ; length of cells = 56–65 μ ; cells with numerous caps.

28. Œdogonium sp.

Sample 4 (red snow !), isolated.

Diam. of cells =8 μ; cells about three times as long as their diameter.

PRASIOLACEÆ.

29. Prasiola crispa (*Lightf.*), *Ag. Sp.* p. 416; *Kütz. Tab. Phyc.* v. t. 40. fig. 6.

Samples 8, 9, 11, 12, and 16, abundant ; numerous early stages in sample 16.

This form is already well known as occurring in Antarctic regions. It

was first recorded by Hooker and Harvey ("Botany of the Antarctic Voyage," Flora Antarctica, vol. ii. pp. 498–499) as *Ulva crispa*, Lightf., as occurring in "Berkeley Sound, Falkland Islands; on moist rocks; Cockburn Island, Graham's Land; very abundant." They add the comment: "a highly interesting species, because it is one of the very few terrestrial plants that have been gathered on the limits of vegetation both in the Northern and Southern Hemisphere." Subsequently it was recorded by Hariot from Cape Horn, by Svedelius from Patagonia, and by Wille from Cape Adaire ("Antarktische Algen. Mitteilungen über einige von C. E. Borchgrevink auf dem antarktischen Festlande gesammelte Pflanzen," in Nyt Mag. f. Naturvidenskab. xl. 1902, pp. 209–219). The various authors who have dealt with this Antarctic form have held rather different views as to the specific determination, several (such as Kützing, Rabenhorst, Svedelius) regarding it as a distinct species, *Prasiola antarctica*, Kütz. These different views are fully considered in the paper of Wille above cited. On the basis of a careful investigation of Borchgrevink's material from Cape Adaire, Wille himself (*loc. cit.* p. 217) comes to the conclusion that there is no true point of difference between *P. antarctica* and *P. crispa* and that the Antarctic form belongs to the widely distributed *P. crispa*.

The material from the South Orkneys showed the characters which have led the above-mentioned authorities to regard the Antarctic form as a distinct species, viz. large interspaces between the areolæ * and prominent thickening of the outer walls of the cells. In the former respect the South Orkneys material differed markedly from the figures shown by Wille (see his pl. iii. fig. 1 and pl. iv. figs. 1 & 2). There can therefore be no doubt that some of the Antarctic *Prasiola* is distinguished from the normal *P. crispa* by these characters, but it may be questioned whether they warrant the establishment of a distinct species. The differences, especially as they appear to grade into one another to some extent (*cf.* Wille, p. 217), are not of specific value, and the case would perhaps be best met by regarding the Antarctic type as a forma *antarctica* of *P. crispa*. It seems very probable that the normal *P. crispa* also occurs in Antarctic regions side by side with the special form and that the material which Wille investigated was the actual *P. crispa*.

My material showed most of the stages figured by Wille in his pl. iii. Numerous filaments of the *Hormidium*-stage were observed, but in many of them a considerable number of the cells were dead or dying, and it appeared that the filaments were undergoing fragmentation without coming to anything further. Stages like those shown in Wille's figs. 13 & 14 were also not uncommon. Little detached groups of cells, like those of Wille's figs. 11 & 12, were very common in the sediment at the bottom of the

* In spite of careful investigation I was unable to make out that these areolæ were occupied by fungal filaments.

tubes. It appears that such groups of cells are not necessarily formed only in the marginal portion of the thallus. In some specimens there were extensive strips of the thallus in which the cells were obviously in a moribund condition, and in the centre of such patches there was often a small rounded group of living cells with very abundant contents. The surrounding dying cells were of considerably larger dimensions than the others and looked as though they had not divided recently. No doubt, the central group of living cells becomes freed by the dying away of the surrounding part of the thallus and acts as an organ of vegetative propagation.

The cells of the South Orkneys material had a curious purplish or olive-brown tinge, which is probably due to the action of the preservative (1 % phenol); staining with iodine brought out the chloroplast and pyrenoid very plainly. The dimensions were as follows:—width of cells $=4\,\mu$; length $=6\,\mu$; thickness (*i. e.* dimensions at right angles to surface of thallus) $=13\,\mu$. There was always only a single layer of cells.

CONJUGATÆ.

MESOTÆNIACEÆ (sensu Oltmanns).

30. Mesotænium Endlicherianum, *Naeg. Gatt. einzell. Alg.* 1849, p. 109, t. 6 B; *West & West, Brit. Desm.* 1904, p. 56, pl. 4. figs. 20, 21.

Sample 15, fairly common; samples 1 and 3 (yellow snow!), isolated.

There appeared to be more than two pyrenoids. Cells 24–26 μ long, 8–9 μ broad.

31. Cylindrocystis Brébissonii, *Menegh. Monogr. Nostoch.* 1842, p. 89. t. 12. fig. 13; *West & West, Brit. Desm.* 1904, p. 58, pl. 4. figs. 23–32.

Sample 8, fairly common. Previously recorded from South Georgia (*Reinsch*).

Two elongated pyrenoids mostly very obvious. Length of cells $=50$–$54\,\mu$; breadth $=13\,\mu$.

32. Cylindrocystis crassa, *De Bary, Conj.* 1858, pp. 37. 74, t. 7. fig. C, 1–2; *West & West, Brit. Desm.* 1904, p. 59, pl. 4. figs. 33–38.

Samples 8 and 9, fairly common.

Cells 32–35 μ long; 14–15 μ broad. Two rounded pyrenoids. Cells occasionally very slightly curved, with broadly rounded ends.

ZYGNEMACEÆ.

33. Mougeotia sp.

Sample 8: only one filament of four cells seen.

Cells 31 μ broad; six times as long.

34. ZYGNEMA sp.

Sample 4 (red snow!); one very much shrunken filament of about twenty cells.

Diam. of cells $=28\ \mu$; cells of the same length, or one and half times as long as broad.

HETEROKONTÆ.

CONFERVACEÆ.

35. CONFERVA BOMBYCINA, *Ag. Syst.* p. 83, n. 10; *Rabenhorst, Fl. Europ. Alg.* iii. 1868, p. 323; f. MINOR, *Wille, Algol Mitteil., in Pringsh. Jahrb.* xviii. p. 467.

Samples 8, 9, 10, 15, rather rare.

Diam. of cells $=6\ \mu$; 2-3 times as long.

CYANOPHYCEÆ.

CHROOCOCCACEÆ.

36. SYNECHOCOCCUS ÆRUGINOSUS *Naeg. Gatt. einzell. Alg.* 1849, p. 56, t. 1 E. fig. 1.

Samples 10, rather rare.

Cells isolated or in twos; diam. of cells $=3\ \mu$.

37. ENTOPHYSALIS GRANULOSA, *Kütz. Phyc. gen.* 1843, p. 177, pl. 18. fig. 5.

Sample 16, common.

38. ?APHANOTHECE SAXICOLA, *Naeg. Gatt. einzell. Alg.* 1849, p. 60, t. 1 H. fig. 2.

Sample 11, rare.

39. MICROCYSTIS OLIVACEA, *Kütz. Phyc. gen.* p. 170; *Rabenhorst, Fl. Europ. Alg.* ii. 1865, p. 51.

Samples 8, 9, 10, 11, and 14, rather common. Previously recorded from Kerguelen (*Reinsch*).

40. MICROCYSTIS MERISMOPEDIOIDES, *F. E. Fritsch.* (Text-fig., E, p. 323.)

Familiæ parvæ solidæ circumferentia irregulari constant ex cellulis pusillis quæ muco fusco-flavescente vel rarius achroo et, ut videtur, tenaci cohærent Cellulæ in facie familiæ quaternariæ regularissime dispositæ (ut in genere

Merismopedia) ; dispositio cellularum in partibus interioribus familiæ investigari non potest, sed dispositio regularis verisimile est.

Diam. fam. =13–20 μ ; diam. cell. fere 0·7 μ.

Samples 11 and 14, common.

In view of the very minute size of the cells and their dense aggregation, it has been impossible to determine exactly their arrangement in the interior of the solid colonies, but focussing in different planes seems to show that the same regular arrangement obtains all through. It is possible that this species belongs to the genus *Eucapsis*, described by Clements and Shantz (Minnesota Bot. Studies, iv. 1909, p. 134) ; but in the latter genus the colonies are described as cubical, which in no way applies to the rather irregular colonies of *M. merismopedioides*. The colonies closely resemble those of a *Microcystis* in all except the regular arrangement of the minute cells.

41. Clathrocystis reticulata (*Lemm.*), *Forti, Sylloge Myxophycearum*, 1907, p. 96.
Sample 10, rather rare.

42. Gomphosphæria aponina, *Kütz. Tab. Phyc.* i. t. 31. fig. 3; *Rabenhorst, Fl. Europ. Alg.* iii. 1865, p. 56.
Sample 11, rare.

43. Cœlosphærium Kützingianum, *Naeg. Gatt. einzell. Alg.* 1849, p. 54, t. 1 c.
Sample 11, rare.

44. Merismopedia glaucum (*Ehrb.*), *Naeg. Gatt. einzell. Alg.* 1849, p. 55, t. 1 d. fig. 1.
Sample 11, rather rare.

45. Merismopedia tenuissimum, *Lemm. Beitr. z. Kenntn. d. Planktonalgen, in Bot. Centralbl.* 1898, p. 154.
Sample 10, rare.

OSCILLATORIACEÆ.

46. Oscillatoria brevis, *Kütz.*; *Gomont, Oscillariées, in Ann. Sci. Nat. Bot.* sér. 7, xvi. 1892, p. 249, pl. 7. figs. 14–15.
Sample 10, rather rare.

47. Oscillatoria splendida, *Grev.*; *Gomont, loc. cit.* p. 244, pl. 7. figs. 7–8.
Sample 10, rather rare.

48. Oscillatoria subtilissimia, *Kütz. Tab. Phyc.* i. 1845–49, p. 27, tab. 38. fig. 7.
Sample 10, rather rare.

49. Oscillatoria tenuis, *Ag.*; *Gomont, Oscillariées, Ann. Sci. Nat. Bot.* xvi. p. 240, pl. 7. figs. 2 & 3.
Samples 10, 11, and 15, rather rare.
The forma *sordida*, Kütz., was also present.

50. Spirulina subtilissima, *Kütz. Phyc. gen.* 1843, p. 183; *Rabenhorst, Fl. Europ. Alg.* ii. 1865, p. 93; *Gomont, loc. cit.* p. 272, pl. 7. fig. 30.
Sample 10, rather common.

NOSTOCACEÆ.

51. Isocystis infusionum (*Kütz.*), *Borzi, in Nuov. Giorn. Bot. Ital.* x. 1878, p. 468.
Samples 8, 11, 13, 15, 17, rather common.

52. Nostoc minutissimum, *Kütz. Phyc. gen.* p. 204; *Rabenhorst, Fl. Europ. Alg.* ii. 1865, p. 162.
Samples 10 and 11, rather common; 1 and 3 (yellow snow!), rare.

RIVULARIACEÆ.

53. Calothrix æruginea, *Thuret*; *Bornet et Flahault, Nostocacées hétérocystées*, 1886–88, p. 358.
Sample 14, isolated.
Diam. of cells =9–11 μ. Only one group of filaments was seen, and the determination is therefore somewhat doubtful. *C. æruginea* is a marine form, but the habitat from which sample 14 came would be likely to harbour marine forms.

DIATOMACEÆ.

54. Melosira varians, *Ag. Consp.* 1830, p. 64; *Rabenhorst, Fl. Europ. Alg.* i. 1864, p. 40.
Sample 9, rather rare.

55. Melosira Sol, *Kütz.*; *Van Heurck, Atlas*, pl. 91. figs. 7–9.
Sample 4 (red snow!); one short chain seen (living!). Previously recorded from the Antarctic (*Hooker & Harvey*).

56. Coscinodiscus radiatus, *Ehrenb.* (1838); *Rabenhorst, Fl. Europ. Alg.* i. 1864, p. 34.

Samples 4 and 6 (red snow!), isolated. Previously recorded from Kerguelen (*Hooker & Harvey*).

A small form (diam. valv. =40–60 μ), otherwise agreeing with the existing descriptions.

57. Triceratium sp.

Sample 4 (red snow!); only a single dead individual seen, but fragments of the valves common.

The single individual seen closely resembled Van Heurck's (Atlas, pl. 112. fig. 1) and Wolle's (Diatomaceæ of North America, pl. 105. fig. 8) figures of *T. arcticum*, Bright, in the character of the areolæ (small at the 3 corners!); the general shape was more that of *T. repletum*, Grev., var. *balearica*, Grun. (Van Heurck, *loc. cit.* pl. 110. fig. 7).

58. Synedra sp.

Sample 11, rare.

59. Eunotia gracilis, *W. Smith, Brit. Diat.* i. 1853, p. 16 & pl. 30. fig. 249.

Sample 9, rather common.

A form with but very slightly recurved ends. Length of valve =22 μ; breadth 2 μ.

60. Cocconeis costata, *Greg. Trans. Micr. Journ.* v. 1857, p. 68, pl. 1. fig. 27.

Samples 9 and 10, rare.

61. Navicula borealis (*Ehrenb.*), *Kütz.*; *Van Heurck, Synopsis Diat.* 1885, p. 76, pl. 6. fig. 3.

Samples 4, rare; 9, 13, and 17, rather common. Previously recorded from Cockburn Island (*Hooker & Harvey*).

Length of valve about 40 μ; breadth 9 μ.

62. Navicula Braunii, *Grun.*; *Van Heurck, loc. cit.* p. 79, pl. 6. fig. 21.

Sample 10, very rare.

Length of valve =37 μ; breadth =12 μ.

63. Navicula Brébissonii, *Kütz.*, var. diminuta, *Van Heurck, loc. cit.* p. 77, pl. 5. fig. 8.

Samples 9, 10, 13, and 15, rather common.

Length of valve =20–34 μ; breadth =5–6 μ.

64. NAVICULA MUTICOPSIS, *Van Heurck, Diatomées, Résult. Voy. 'Belgica' en 1897–99*, Anvers, 1909, p. 12, tab. 2. fig. 181.

Samples 8, 9, 10, 11, and 15, common. Previously recorded from the Antarctic (*Van Heurck*).

Length of valve $=24\,\mu$; breadth (at widest point) $=10\mu$. In most of the individuals the sides of the valves were nearly parallel, but occasionally they were somewhat arched (text-fig. 1, B); ends very pronouncedly swollen in a capitate manner.

65. ? NAVICULA LUCIDULA, *Grun.*; *Van Heurck, Atlas*, 1880–81, pl. 14. fig. 40.

Sample 9, rather rare.

Certainly a very close ally of this species.

66. NAVICULA MUTICA, *Kütz.*; *Van Heurck, Synopsis Diat.* 1885, p. 95, pl. 10. fig. 17.

Samples 8, 9, 10, 13, and 17, common. Previously recorded from the Antarctic (*Reinsch, Holmboe*).

Length of valve $=16\,\mu$; breadth $=7\text{–}8\,\mu$.

67. AMPHORA OVALIS, *Kütz.*; *Van Heurck, Synopsis Diat.* 1885, p. 59, pl. 1. fig. 1.

Sample 4 (red snow!), isolated. The var. *gracilis* has previously been recorded from Kerguelen (*Reinsch*).

68. GOMPHONEMA MONTANUM, *Schum.*; *Van Heurck, Synopsis Diat.* 1885, p. 124, pl. 23. figs. 33 & 36.

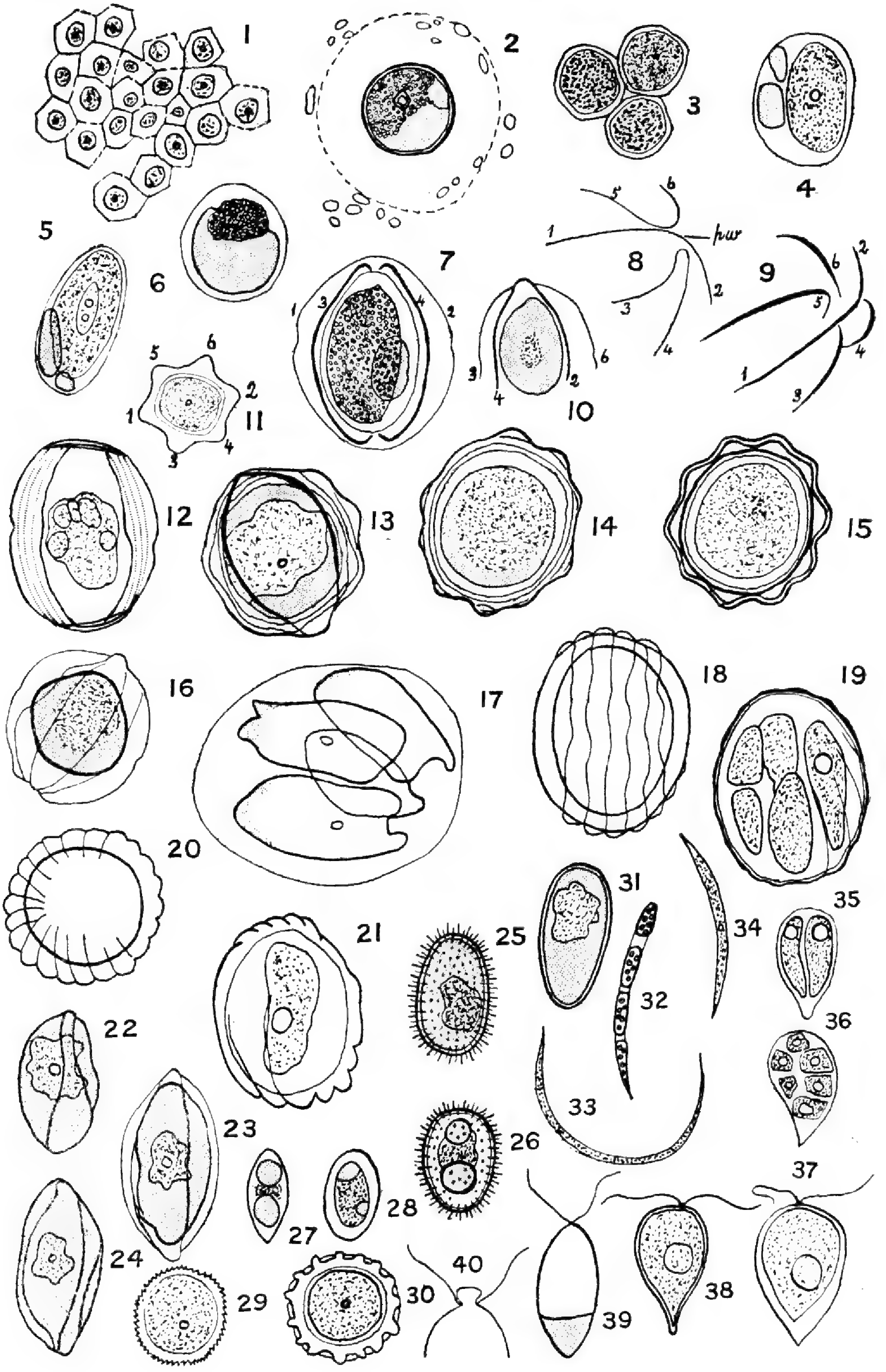
Sample 9; isolated specimens.

EXPLANATION OF THE PLATES.

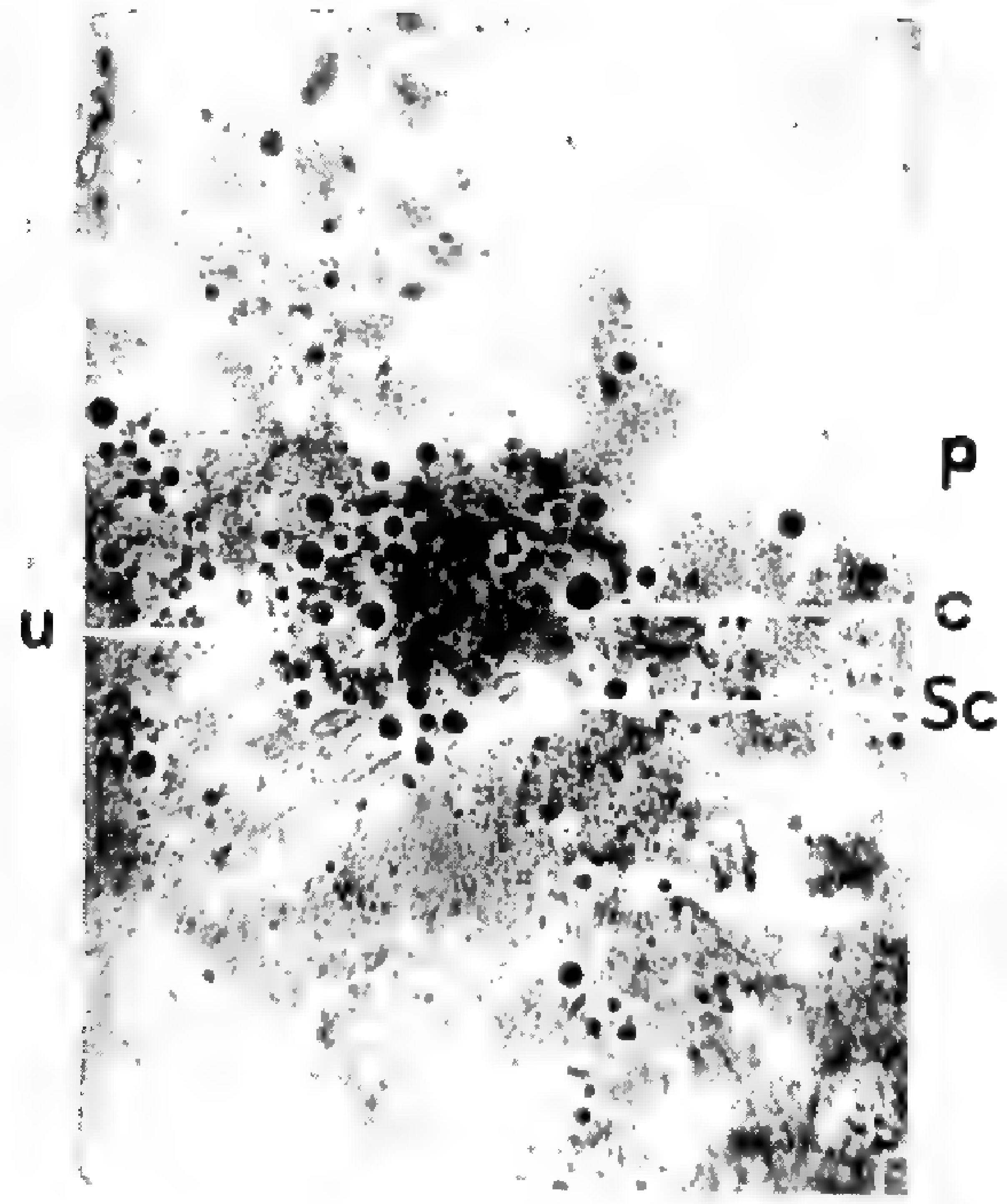
PLATE 10.

Fig. 1. *Protoderma Brownii*, F. E. Fritsch. A small portion of one of the sheets of cells formed by this species. (×830.)

Figs. 2–6. *Chlorosphæra antarctica*, F. E. Fritsch. Fig. 2. Large isolated cell with a wide mucilage-sheath and a quantity of fat in the cell-contents (×540). Fig. 3. A group of small cells without mucilage-sheath; fat equally diffused through the contents (×1100). Figs. 4, 5. Oval cells with segregated masses of fat; possibly a stage in which the cells are preparing to divide (*cf.* p. 303) (×830, 730, respectively). Fig. 6. A cell in which the fat is very prominently developed (×540).



FRESHWATER ALGÆ.



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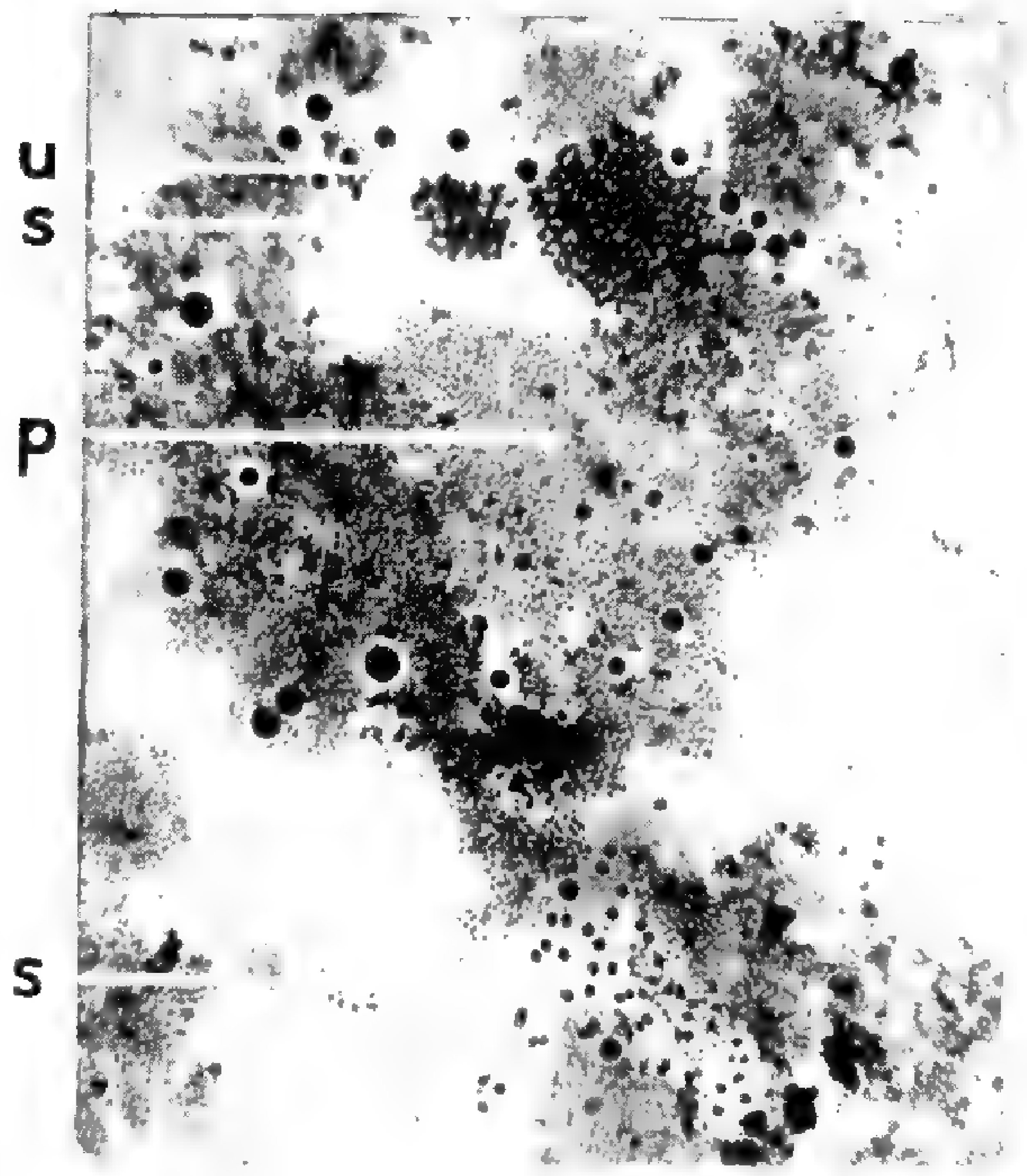

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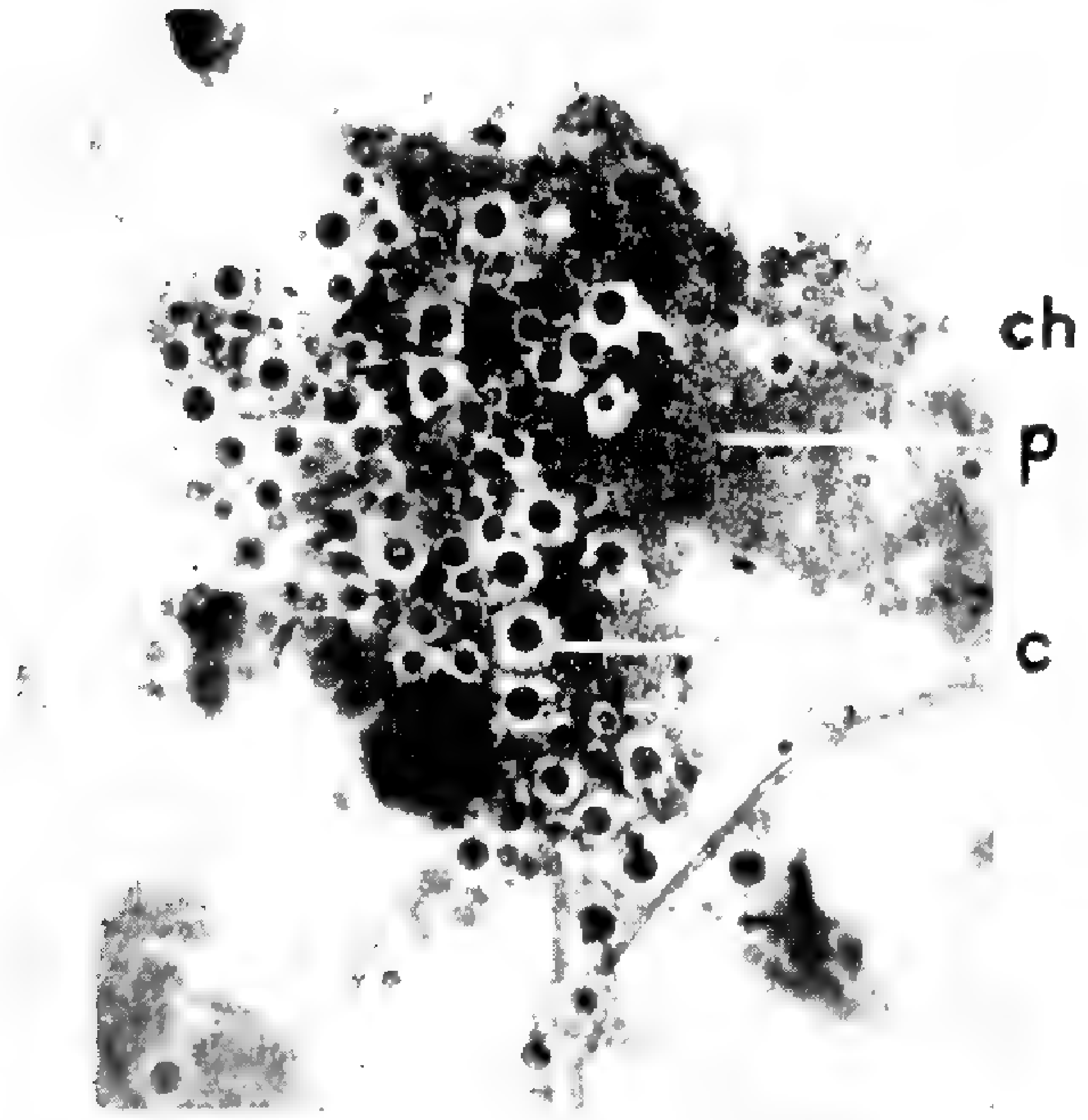

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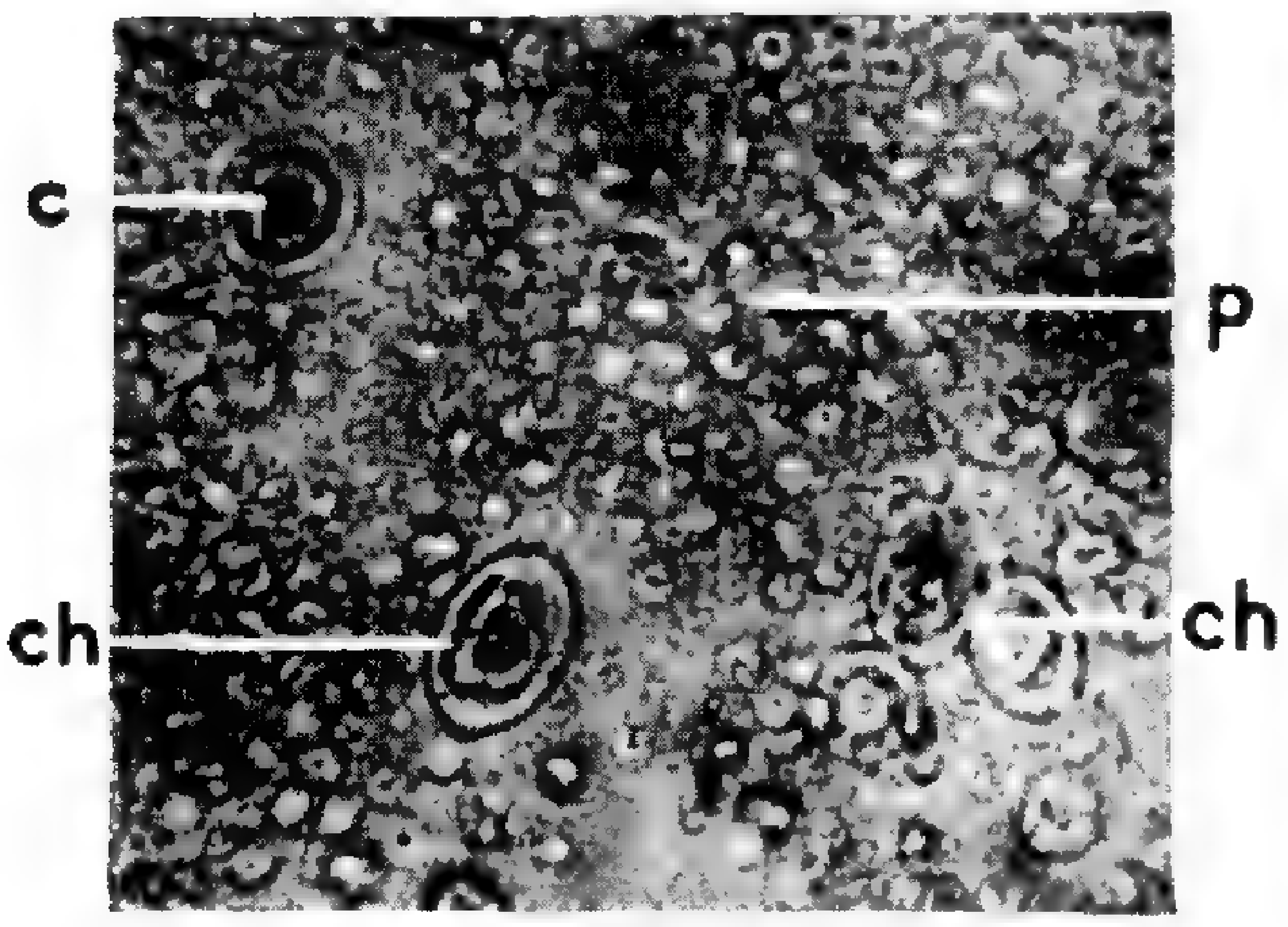

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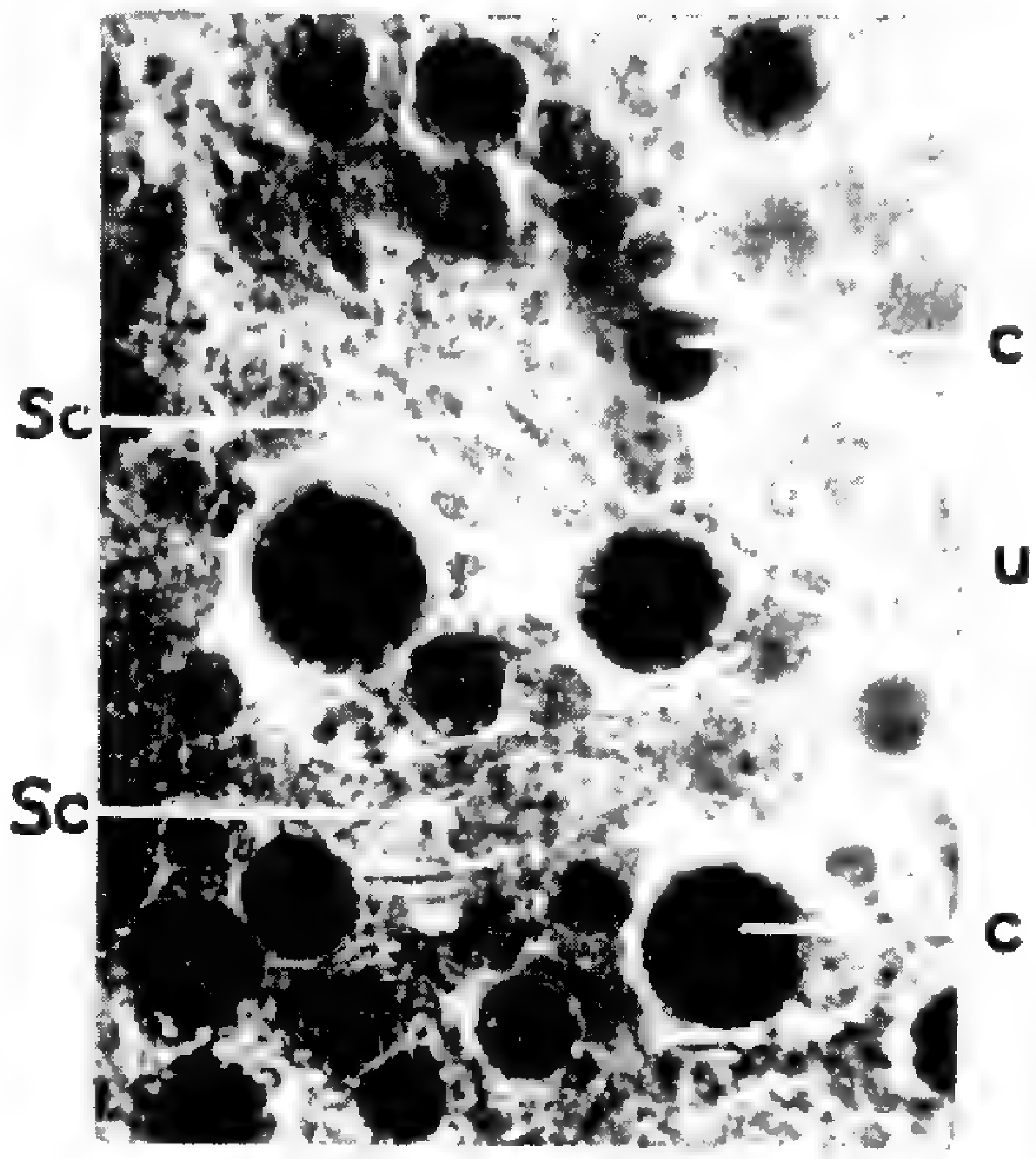

6

FRESHWATER ALGÆ.

Figs. 7–11. *Scotiella antarctica*, F. E. Fritsch. 1–2=principal wings; 3–4 and 5–6=the two pairs of lateral wings; *pw*=principal wings. Fig. 7. A rather small normal individual, as seen when the principal wings are parallel to the substratum (×830). Figs. 8, 9. Two oblique end-views of the organism to show the course of the wings (×830). Fig. 10. Part of a normal individual in which the principal wings are inclined to the substratum (×540). Fig. 11. An individual seen in optical section (×430).

Figs. 12–16. *Scotiella antarctica*, F. E. Fritsch. Stages in formation of resting-spores (?). Fig. 12. An individual in which the wings have lost in definition (×540). Figs. 13, 14, 15. Three stages in the production of the resting-cell (×540). Fig. 16. An early stage in the formation of a resting-cell; contents rounded off and wings irregular (×410).

Fig. 17. *Scotiella antarctica*, F. E. Fritsch. A possible stage in the production of four new individuals (×1100).

Figs. 18–21. *Scotiella polyptera*, F. E. Fritsch. Fig. 18. An individual seen from the side, showing the numerous undulated wings; contents not figured (×1100). Fig. 19. Production of four new individuals; wings on mother-cell indistinct, but showing the spiral trend (×1500). Fig. 20. Oblique end-view of an individual to show the course of the wings (×1100). Fig. 21. A normal individual seen from the side, showing the shrunken cell-contents, the spiral wings, and the crenate outline of the whole cell (×1100).

Figs. 22–24. *Pteromonas nivalis* (Shuttelw.), Chodat. Three individuals, showing the course of the wings and the contracted contents. (×830.)

Figs. 25–26. *Chodatella brevispina*, F. E. Fritsch. Two individuals showing different methods of distribution of the fat. (×830.)

Figs. 27–28. *Oocystis lacustris*, Chodat, f. *nivalis*. Two isolated cells from the yellow snow. (×830.)

Fig. 29. *Trochiscia nivalis*, Lagerh. (×1100.)

Fig. 30. „ *antarctica*, F. E. Fritsch, from the yellow snow. (×1100.)

Fig. 31. *Pteromonas nivalis* (Shuttelw.), Chodat? (×1100.)

Figs. 32–33. *Raphidonema nivale*, Lagerh. (×830.)

Fig. 34. *Raphidium pyrenogerum*, Chodat? (×1100.)

Figs. 35–40. *Chlamydomonas caudata*, Wille. Figs. 35, 36. Subdivision of the cell-contents (×650). Figs. 37, 38. Two normal individuals (×750). Fig. 39. Individual with a very strongly thickened posterior tip (×750). Fig. 40. Front end of an individual to show a prominent beak between the two cilia (×830).

PLATE 11.

(All the photographs * on this Plate are representations of stained material of yellow snow at various magnifications. The following symbols are used: *C*=*Chlorosphæra antarctica*, F. E. Fritsch; *Ch*=*Chodatella brevispina*, F. E. Fritsch; *P*=*Protoderma antarctica*, F. E. Fritsch; *S*=*Sphærocystis Schröteri*, Chodat; *Sc*=*Scotiella antarctica*, F. E

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* The photographs on this Plate were made with the help of a photomicrographic apparatus purchased by a research-grant made by the Governors of the East London College, University of London. I am much indebted to my friend Mr. E. Hatschek for assistance in taking the photographs.

Fritsch; *U*=*Ulothrix*. Photographs 1, 2, and 3 are magnified 130 times; photographs 4, 5, and 6 are magnified 400 times.)

Photographs 1 *and* 2.—Typical views of the yellow snow flora at a low magnification. In the first photograph *Protoderma antarctica* is very predominant, but in the centre is seen a group of fairly large *Chlorosphæra*-cells, together with three individuals of *Scotiella antarctica*. Short filaments of *Ulothrix* are visible at several points in the photograph. The second photograph shows a very typical stratum of *Protoderma* near the centre, two young colonies of *Sphærocystis* at the upper end and an older colony towards the base. *Chlorosphæra*-cells of various sizes and often exhibiting well-marked mucilage-sheaths are obvious at many points in the photograph.

Photograph 3.—This shows a very typical group of large *Chlorosphæra*-cells with well-marked sheaths together with a thick patch of *Protoderma*. At the right-hand side of the photograph a number of oval individuals of *Chodatella* are to be seen.

Photograph 4.—An individual of *Scotiella antarctica*, F. E. Fritsch, showing the two principal and two lateral wings. The notch in the right-hand principal wing is very obvious. At the lower end of the individual the two lateral wings can be seen curving inwards.

Photograph 5.—A small part of a *Protoderma*-sheet highly magnified (only the cell-contents are recognisable) and showing a number of individuals of *Chodatella brevispina*, F. E. Fritsch. The small spines on the latter are scarcely visible.

Photograph 6.—This shows part of the central group of cells in photograph 1 on an enlarged scale. Three individuals of *Scotiella*, a number of *Chlorosphæra*-cells and *Ulothrix*-filaments are visible, while the ground-mass consists of *Protoderma*.

AN ECOLOGICAL STUDY OF A CAMBRIDGESHIRE WOODLAND.

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(PLATES **12**-**17** and 1 Text-figure.)

[Read 16th March, 1911.]

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INTRODUCTION.

THE detailed study, both experimental and descriptive, of plant-associations * has of recent years received a certain amount of attention from ecologists in various parts of the world. Clements † was one of the first to insist upon the necessity of experimental work in ecology to make real advances, and his book is invaluable for suggestions as to the modes of attacking various problems.

Of work dealing with woodlands in particular, the paper by Hesselman ‡ on the Swedish "Löfängar," or "Wood-meadows," and Woodhead's § "Ecology of Woodland Plants in the Neighbourhood of Huddersfield" are perhaps the most important.

In addition to these, numerous American workers have studied the conditions in the natural forests on the other side of the Atlantic.

* Moss, 1910 *b*.
† Clements, 1905, p. 161.
‡ Hesselman, 1904.
§ Woodhead, 1906.

GAMLINGAY WOOD.

Situation.—The woodland studied, Gamlingay Wood, is situated in the extreme west of Cambridgeshire, on the borders of that county and Huntingdonshire, in which county a small portion of the wood lies.

The wood is in lat. 52° 10′ N. and long. 0° 11′ W. It is about 15 miles almost due west of Cambridge in the parish of Gamlingay and about half a mile north of the village of that name.

The wood is on the summit of a ridge rising to slightly more than 200 ft. above the Ordnance datum.

The wood itself is on approximately level ground except for a slight slope downwards at the southern end. In shape it is roughly rectangular, being about $\frac{3}{4}$ mile long by $\frac{3}{8}$ mile in width, with the long axis running N.E. by S.W.—*i. e.*, about one quarter of a square mile in extent.

Gamlingay Wood is the property of Merton College, Oxford, and is rented by Col. Duncomb, of Waresley Park, Hunts, whom I desire here to thank very cordially for his kindness in allowing me access to the wood at all times of the year.

Geology.—The wood is mapped, on the Geological Survey map, as on Gault, and close to the boundary-line between that formation and the Lower Greensand, which extends for a considerable distance to the west and south of the wood. But in the geological map in the 'County Geography' * Lower Greensand is marked as the underlying rock. The underlying rocks, however, in this spot are all overlaid by that extremely variable deposit known as Boulder Clay, which forms a cap to the ridge on which the wood stands. The details of the structure and composition of the Boulder Clay will be discussed later.

There seems some evidence that part, at any rate, of the Boulder Clay in the wood is underlaid by Greensand, especially in the western part. Diggings here revealed the fact that the soil becomes bright yellow and much more sandy at a depth of 18 ins. to 2 ft., and locally lumps of undoubted Greensand were turned up.

In one part solid Greensand was struck at a depth of 7–8 feet. In an adjoining field also, immediately west of the wood and on the same level, sand was recently turned up, during drainage operations, at a depth of 2–3 feet.

The clay in the wood seems to be on the average considerably more than 4 ft. in depth.

* Hughes, 1909.

CLIMATE.

Rainfall.—The mean annual rainfall * for the period of 30 years (1880–1909) taken at Waresley Park, about a mile from the wood, is 23·64 ins. (60·04 cm.). This is slightly higher than that of Cambridge *, which for the same period is 22·36 ins. (56·84 cm.). The difference, however, is too small to make any appreciable change in the vegetation, especially as the distribution of rainfall is practically the same in the two places.

On the monthly means for the last 10 years (1900–1909) June is the wettest month with 6·27 cm. at Waresley—closely followed by August and October with 6·07 and 5·86 cm. respectively. This excess in June, however, is somewhat compensated for by the fall being more concentrated. Thus the average number "rain days," that is days in which ·025 cm. or more falls, is 11 in June and 17 in October.

The accompanying table gives the mean monthly rainfalls for the years 1900–1909 at Cambridge and Waresley, together with the number of "rain days":—

	Cambridge.		Waresley.			Cambridge.		Waresley.	
	cm.	Rain days.	cm.	Rain days.		cm.	Rain days.	cm.	Rain days.
Jan. ..	3·40	13	3·45	14	July ..	5·00	10	5·66	10
Feb. ..	3·48	13	3·53	14	Aug. ..	5·03	14	6·07	14
Mar. ..	3·96	15	4·44	16	Sept. ..	3·17	10	3·45	11
Apr. ..	3·86	13	4·01	13	Oct. ..	5·76	16	5·86	17
May ..	4·90	13	5·20	11	Nov. ..	4·37	11	4·26	14
June ..	6·30	12	6·27	11	Dec. ..	4·70	15	4·95	16

Temperature.—The mean annual temperature at Cambridge calculated on a 24 years' average is 50·3° F.=10·2° C. January is the coldest month with an average temperature of 38·6° F. (3·7° C.), and July the warmest with 63·7° F. (17·6° C.).

Complete monthly averages are †:—

	° F.	° C.		° F.	° C.
Jan.	38·6	3·66	July	63·7	17·6
Feb.	41·2	5·1	Aug.	63·3	16·72
Mar.	42·6	5·77	Sept.	58·5	14·73
Apr.	48·6	9·2	Oct.	51·2	10·6
May	53·9	12·16	Nov.	42·5	5·94
June	60·4	13·4	Dec.	39·3	4·05

The following figures showing the monthly ranges of temperature are taken from Jenyns ‡, and are calculated for 17 years at Swaffham Bulbeck:—

* British Rainfall. † Bartholomew, 1903, p. 922.

‡ Jenyns, 1858, pp. 381 *et seq.* & p. 19.

	Mean daily max.	Mean min. at night.	Mean range.
January	40·8° F.	32·7	51·84° to 19·58°
February	43·4	33·1	53·58 „ 22·81
March	48·2	35	58 „ 23·6
April	53·7	37·8	67·8 „ 27·86
May	62·5	43·9	74 „ 33·75
June	68	50·9	78·2 „ 41·66
July	70·8	53·2	80·61 „ 42·79
August	70	53·2	79·47 „ 43·13
September	65·2	49·5	74·53 „ 36·35
October	56·2	43·9	66·08 „ 31·42
November	48	37·4	57·92 „ 26·79
December	43·5	35·1	54·4 „ 24·23

Wind.—The prevailing wind during the summer months, June to September, is W. to S.W., less often S. or N.W. Easterly winds are prevalent during the early summer, April and May.

Soil.

As mentioned previously, the soil consists of Boulder Clay, which in this wood can be divided into two sharply marked areas. The first, which is much the larger of the two, consists of a heavy stiff calcareous clay or marl, which is bluish or grey in colour. This soil is very fine-grained, with few stones at the surface but irregular bands of flints below. The surface soil here extending to about 1 inch in depth is dark-coloured owing to the presence of humus; below this for a depth of 18–20 ins. the soil is a very homogeneous clay, brown to yellowish in colour, with occasional flints. From about 22 inches onwards chalk becomes freely mixed with the clay in small or larger nodules. The whole soil here is of a much lighter grey colour. Even at depths of about 4 ft. the soil remains similar in character; beyond this depth * probably no roots even of trees would extend in a soil so well supplied with water, and, indeed, in this soil, except for the trees, few if any roots penetrate more than about 7 inches.

The other type of soil occupies a smaller area in the wood mainly on its western side. The soil here is a loam, much lighter and more friable than the former type. It consists of a mixture of coarse sand and clay. There is an inch on the surface with a large amount of humus; below this the soil is darkish in colour to a depth of about 6 inches. Beyond this depth the

* Schlich, 1904, p. 36.

soil is a bright yellow or brown colour and continues so with little alteration to considerable depths. This soil contains many more stones all through it than does the clay ; these are chiefly flints. Roots here also penetrate to a considerable depth, the shrubs' roots extending to more than 25 inches.

In the paper these two soils will be referred to as the calcareous clay or marl and the loam respectively. They are usually sharply marked off from one another with only a comparatively narrow band of intermediate soil.

Some diggings were made on the clay side of this region. Here there were about 5 inches of fairly uniform soil coloured dark with humus. This soil is a mixture of clay and coarse sand ; up to about 18 inches the amount of sand is much less and the soil more yellowish in colour. Beyond about 18 inches chalk begins to appear, and the soil below this is the same as the deeper layers of the calcareous clay.

In general appearance these two soils are quite distinct ; in winter the calcareous clay becomes very wet and muddy, with water collecting in hollows, while in summer exposed parts become very dry and crack freely on the surface. The loam never gets so wet on the surface and does not crack and harden in dry weather to the same extent.

Some mechanical analyses of these soils have been undertaken. The two soils show certain distinct differences in the relative proportions of the fine and coarser grained materials. In the separation by subsidence the marl soils showed 30–40 per cent. of the very fine-grained materials or "clay," while the loam gave 20–25 per cent. The latter also showed a greater proportion of the sandy materials. The calcareous clay agrees fairly well with the soil from the London Clay mentioned by Hall *, as regards mechanical composition. Foreman † gives analyses of arable soils from the Cambridgeshire Boulder Clay which correspond with those in the wood :—

	Boulder Clay over Gault.	Boulder Clay over Greensand.
Stones	2·00	1·8
Fine gravel	0·38	0·67
Coarse sand	10·67	14·79
Fine ,,	14·95	18·55
,, silt	11·85	16·37
,, silt	13·53	12·35
,, clay	26·95	22·28
Moisture	3·66	3·24
Loss on ignition	9·6	7·73
$CaCO_3$	5·71	0·58

In regard to chemical analysis, the chief point I have investigated is the percentage of lime, $CaCO_3$.

* Hall, 1908, p. 56. † Foreman, 1907, p. 168.

The following complete analysis is again from Foreman * :—

	Over Gault.	Over Greensand.
Moisture	3·66	3·24
Organic matter	9·69	7·73
Insol. siliceous matter...	63·87	73·62
Lime (CaO)	3·95	0·78
Magnesia (MgO)	0·285	0·28
Phosphoric Acid (P_2O_5)	0·14	0·113
Potash (K_2O)	0·948	0·785

The first of these, that over Gault, corresponds to the calcareous clay in the wood, while the second shows some resemblance to the loam. The similarity of the loam to this soil both in mechanical and chemical analyses is further reason for associating it with Greensand. The two types of soil in the wood gave considerable differences as regards the percentage of carbonate of lime. This was estimated by the amount of CO_2 evolved in treatment with hydrochloric acid. Various methods were used, but that of Amos † was found most satisfactory. As the amount of organic material was comparatively so small it was not considered necessary to undertake any special methods to counteract the effect of CO_2 given off from that source ‡. The loam soils gave little or no effervescence on the application of acid, while the clays showed considerable differences in this respect. Some of them gave a vigorous effervescence, while others showed a just visible amount or none.

The percentage of lime, calculated on the dry weight of the soil dried at 100° C., in the marl ranged from 7 to 1·5 per cent.; more than half the samples gave 3 to 4 per cent.; while the loam soils ranged from 1·5 to practically none at all, giving an average of 0·8 per cent.

Foreman * gives 1 per cent. as the average lime-content of the Cambridgeshire Boulder Clays for agricultural soils. However, one of his examples, from a clay above Gault, gave 5·71 per cent. for the first seven inches. The higher average percentage for the clay in the wood would seem to be due to the lessening in the amount of leaching out that takes place there as compared with an agricultural soil.

The water in the calcareous clay soil is neutral to test-paper, that of the loam is also neutral or with a slight tendency to acidity locally.

The humus-content of these soils has also been studied as being a factor with a distinct influence on the vegetation. The amount of humus present was obtained by heating to a red heat for a prolonged period a dried sample of soil which was as free as possible from portions of roots and other extraneous matters that would vitiate the results. The samples were taken from the layers of soil about the roots of the principal species of the ground flora. The heating was continued till a constant

* Foreman, 1907, pp. 167–169. † Amos, 1905. ‡ Marr, 1909.

weight was obtained. The calcareous clay soils treated in this way show a percentage of organic matter varying from 15·9 to 6·9, giving an average over a large number of samples of 10·97 per cent. The figures for the loam are rather lower—averaging 8·34, the maximum being 9·75 per cent. These averages correspond very closely with those quoted from Foreman above.

These figures were obtained from soil samples taken below the surface, allowance being made for the decomposition of carbonates: the raw humus that accumulates on the surface to the thickness of half an inch was not taken into account; otherwise the figures for the loam would be much higher, about 14 per cent.

The point in connection with the soil that so far has been most studied is the water-content, a point of extreme importance with regard to the vegetation * †. Samples of soil for this purpose have been taken at intervals throughout the year; so far as was possible all samples were taken from those layers of soil in which the roots of the principal species spread. The usual method employed by agriculturists of taking samples of 7 or 9 inches ‡ depth does not give an adequate idea of the soil used by definite plants.

The method employed to obtain the water-content was to heat the sample of soil in an oven at 100° C. till a constant weight was obtained. The sample on collection was placed in an air-tight tin and brought in and weighed in the laboratory as soon as possible after collection, and in all cases on the same day, to render the error by loss of water in transit as little as possible.

Samples of soil dried by simply leaving them exposed at the temperature of an ordinary room, protected from dust, &c., take a very long time to dry, and, even when apparently so, always contain an appreciable quantity of water, varying with the atmospheric conditions. For this reason the oven method of drying was found more satisfactory as well as being very much quicker.

The percentages of water are in all cases calculated on the dry weight of the soil, and not, as often is the case, on the weight as collected.

In connection with the water-content of soil, a feature that has been emphasised as of the greatest importance, especially in comparing different soils, is the water-holding capacity of the soil § ‖. This was measured by the method suggested by Livingston ‖: the dry soil was placed in a vessel with a porous base and saturated with water, and then allowed to drain till water just ceased to come away in drops; the amount of water then present gives the water-holding capacity. The calcareous clay has a water-holding capacity of about 46 per cent., while that of the loam is about 43. This is a factor which is of special importance in cases where the water-table

* Warming, 1909, p. 47. † Clements, 1905, p. 25. ‡ Hall, 1908, p. 48.
§ Schimper, 1903, p. 84. ‖ Livingston, 1910, p. 245.

is very deep down, as in the desert soils studied by Livingston * †, but in these soils the water-table in winter rises almost or quite to the surface, when the soil becomes supersaturated with water. Indeed, in parts of the calcareous clay the water-table is only about 3–6 inches below the surface at the beginning of the growing season, unless the conditions have been very dry. In summer the water-holding capacity becomes of much greater importance as the water-table sinks lower and lower, and, indeed, in some of the more sandy parts of the loam, where it is only about 36 per cent., the soil near the surface may get very dry.

As a whole the calcareous clay soil shows a higher water-content than those of the loam, the difference being especially pronounced in summer. The average content for the year for the marl is 39·8 per cent., and for the loam 18·2. These annual average contents, however, do not give much idea of the conditions under which the plants grow, the essential points being the water present at the critical period, or period of most rapid growth *. The details, however, will be considered later in relation to the conditions they affect.

With regard to the ratio of water-content to humus, that for the calcareous clay works out at 3·6 and for the loam 2·9. These figures are higher than might have been expected, owing to the poorness of these calcareous soils in humus ‡.

Experiments have been carried out to try and obtain the amount of available water or chresard §. The method advocated by Clements is extremely difficult in practice, especially in removing a block of earth round the roots of the plant without either damaging the roots or considerably upsetting the plant. Experiments, however, were carried out with *Mercurialis perennis* with the result :—

Holard § ...	38·4 per cent.	Average figures as result of several experiments.
Echard §...	12·6 ,, ,,	
Chresard...	25·8 ,, ,,	

These agree fairly closely with the figures for a clay soil obtained by Hedgecock ‖, who used saturated soil as a holard and mesophytic species. His figures are for clay :—

Holard	47·4 per cent.
Echard	9·3 ,, ,,
Chresard	38·1 ,, ,,

* Livingston, 1910, p. 252. † Livingston, 1906, p. 16. ‡ *Cf.* Moss, 1907, p. 52.
§ Clements, 1905, p. 32. ‖ Hedgecock, 1902.

Experiments with other species gave very unsatisfactory results, so that these figures will not be taken into account, and the water-content figures are to be taken as referring to the holard in all cases. But it may be noted here that this never fell so low as the amount of the echard observed, and consequently here the plants never get into a state of extreme drought.

Another feature of the soil that has been studied to some extent is the temperature.

The temperatures were taken with ordinary mercurial thermometers, those of the soils being taken as far as possible for the layers in which the roots of the principal species occur.

In the early parts of the year the soil temperature was considerably below that of the air, but from about March onwards the soil showed a steady rise in temperature with only minor fluctuations. This rise is independent of temporary fluctuations of the air temperature, so much so that the soil may at times be warmer than the air: *e. g.*, on May 23rd, 1910, during a sudden cooling of the air the temperature just clear of the ground vegetation fell to 10·5° C., while the temperature of the marl in parts where it is fairly dry stood at 11·5° C. This drop for the air, however, was only temporary, and later it got well above the soil again.

The temperature of the two soils varies somewhat: the marl being darker in colour would be expected to absorb more heat; and this occurs in the early part of the year when the two are both equally wet, but later in the year the low water-content causes the loam to get considerably warmer than the mass of the calcareous clay—though dry parts of this approach the temperatures of the loam very closely.

The average temperature of the soil in the wood seems practically independent of different degrees of shading that occur, though the more open parts show greater fluctuations and on the whole warm up more slowly in spring.

As is well known the temperature of the surface of the soil is higher than that of the soil or the air; it fluctuates in general with the changes of the air, but the variations are not quite so great as a rule. This warming up of the surface layer is a feature of considerable importance in connection with the sprouting of herbs in the spring, which have their roots and aerial organs at very different temperatures. This might be expected to cause considerable disturbance to the plant were it not for the increased relative humidity at the surface which reduces transpiration *.

The other factors, light and evaporation, will be discussed later along with the details of the societies of the ground vegetation.

* *Cf.* MacDougal, 1903.

Vegetation.

The natural and semi-natural woodlands of England have recently been classified and a scheme drawn up showing their relationships to one another *. In general the woodlands fall into two main series—an *Oak* and *Birch* series, and an *Ash* and *Beech* series. The former are developed on siliceous soils, and the latter on calcareous ones. Each series is further subdivided. Leaving out of consideration those types of wood which occur in upland regions only and those on peaty or acid soils, the divisions are * :—

Oak and Birch Series.

(1) *Quercus Robur Woods* on deep damp clays and loams.
  (1 *a*) *Oak-Hazel Copse*, a subtype formed by coppicing.
(2) *Oak Woods* (*Quercus Robur* and *Q. sessiliflora*) on deep sands in lowlands.
(3) *Quercus sessiliflora Woods* on shallow siliceous soils.

Ash and Beech Series.

(1) *Ash Woods* on limestones with shallow calcareous soils.
(2) *Ash-Oak Woods* on damp marls.
  (2 *a*) (*Ash*) *Oak-Hazel Copse*, a subtype due to coppicing with removal of standard *Ash*.
(3) *Beech Woods* on chalk.

If Gamlingay Wood is looked on in the light of the above classification it will be shown that that part of it which is on the calcareous clay or marl belongs to the second division of the *Ash* and *Beech* series, namely, an *Ash-Oak* wood. That part on the non-calcareous loam belongs to the first division of the *Oak* and *Birch* series, a *Quercus Robur* wood. The present appearance of the *Ash-Oak* wood as a wood with *Oaks* as the dominant standard tree is due to the system of forest cultivation so extensively followed in Southern England. The wood is periodically coppiced and everything almost but the oaks cut down; as a result of this, practically all the *Ash*, which is really quite abundant, at the present day is in the form of shrubs growing from coppiced stools. Thus it belongs to the subtype of the *Ash-Oak Wood*, the (*Ash*) *Oak-Hazel Copse*. Moreover, as will be shown, the ground flora and many of the shrubs are in support of the view that this wood belongs to the *Beech* and *Ash* series †. *Ash-Oak* woods have been described by Moss † in Somerset on calcareous clays, under the name of *Oak-Hazel Woods*. Moss points out the close resemblance of these woods to the *Ash Wood* type. The soil conditions of these Somerset *Oak-Hazel*

* Moss, Rankin, and Tansley, 1910, p. 146. † Moss, 1907, p. 51.

Woods are almost identical with those in this wood ; they are developed on wet heavy calcareous clays which are poor in humus and phosphoric acid.

That part of the wood which occupies the loam area is of quite a distinct type. None of the calcicole or *Ash Wood* type species occur here. The wood belongs to the *Oak* series mentioned above, and to that part of it on deep soils ; this part of the wood is what is known as a *Quercus Robur* wood, and is of the same kind as those occurring on the non-calcareous clays and loams belonging to the Weald Clay and to non-calcareous clays and loams generally in this country.

Thus Gamlingay Wood really consists of two distinct and separate plant associations developed close together.

Gamlingay Wood is situated on the extreme western border of the western area occupied by the Oxlip, *Primula elatior*, as defined by Miller Christy *. *Primula elatior* is confined to the *Ash-Oak* association, and is quite absent from the *Oak* wood on the loam—and this agrees with the general distribution of the Oxlip in East Anglia.

Trees.—The wood is of the type known to foresters as "Coppice with Standards" †. The trees, as in so many of the woods of this country, are small-sized and not of any great age; they stand at considerable distances apart and rarely form a closed canopy over the lower layers of vegetation. The cutting period for the standards, in this particular wood, is quite irregular ; they are cut at intervals according to the size of the trees and the demand. The trees reproduce themselves naturally, and no records of planting occur so far as I have been able to ascertain.

The dominant tree all over the wood is *Quercus Robur* (= *Q. pedunculata* ‡), which occurs equally on the two types of soil. *Q. sessiliflora* is quite absent from the wood and does not occur on the clay or the loam, although it is abundant in a wood 3 miles distant on the Lower Greensand. *Populus tremula*, Aspen, is very abundant in parts of the wood, especially the wetter parts. The trees belong to the variety *villosa*, Lange. In parts the Aspen does not seem to flourish ; after reaching a certain size the trees become "stag-headed" and die off. Suckers are produced freely in the loam region and to a less extent on the clay. A few seedlings were noticed.

Fraxinus excelsior, Ash. As mentioned above, this is not common now as a standard tree. The few full-grown trees are situated near the edges of the wood. Most of the ash standards that occur in the wood proper are small trees that have grown up from coppiced stools by one shoot getting ahead and not having been cut. *Fraxinus* occurs in small quantity on the loam.

Ulmus §, Elm. Elms occur in some quantity in parts of the wood usually

* M. Christy, 1897 (map).
† Schlich, 1904, p. 99.
‡ Moss, 1910 *a*, p. 6.
§ Ley, 1910, p. 65.

in groups and not as scattered trees. Three forms occur in the wood: the Dutch Elm, *U. hollandica*, Mill., which is confined to the edges; another species of Elm, which appears to be *U. sativa*, Mill., is much more numerous, it produces suckers freely. *Ulmus glabra* also occurs.*

Betula, Birch, with the exception of a solitary (single) tree, is confined to the loam area, where it is fairly abundant. Both forms of the tree occur, much the commoner being *B. tomentosa*; the other, *B. alba* (=*B. verrucosa*), is represented by a few individuals only.

Pyrus torminalis, Service Tree. About five or six trees of this species occur in the wood, all on the clay; this is the only locality in the county. Some of the trees are remarkably fine examples; the largest has a circumference of 5 ft. 6 ins. at a height of 4 ft. from the ground. This tree was at one time marked for felling, but the owners refused to allow it to be cut down. *P. torminalis* is mentioned by West † as being probably extinct from the county.

Pyrus Malus, Crab-Apple. A single large example of this occurs in the wood. The apple is more abundant in some of the other *Ash-Oak* woods in the county.

Acer campestre, Maple. Several small trees of this species occur scattered through the *Ash-Oak* part of the wood. Shade-bearing trees, such as *Sycamore*, *Beech*, &c., are quite absent, and the wood is entirely free from planted conifers.

Shrubs.—All over the clay part of the wood there is a thick layer of coppiced shrubs. On the loam area shrubs are much less abundant, and in parts almost absent. The shrubs are cut in definite areas, one each year, the rotation being about 18 years. The length of rotation for coppice shrubs varies in different parts of the country; thus the average rotation in Kent is 10–15 years, while in Somerset ‡ it is 10–12 years.

Corylus Avellana, Hazel, is the dominant shrub all over the wood, either pure or mixed with Ash or other species. Hazel occurs sparingly on the loam.

Fraxinus excelsior is also extremely abundant and in large parts shares dominance with *Corylus*, or locally on small areas it may occur pure. Many of the ash shrubs are growing from extremely large stumps, which seem a further indication of the former greater importance of the species.

Acer campestre is also abundant, but not nearly so much so as the two former. Both the type form and the variety *leiocarpon* occur in the wood.

Ulmus sativa. A small patch of shrubs of this occurs in one part, quite remote from the standard elms. This form has very small leaves and very large cork-wings to the stem.

* For the identification of these Elms I am indebted to Dr. C. E. Moss.

† West, 1898, p. 247. ‡ Moss, 1907, p. 52.

Salix cinerea, the Grey Sallow, occurs in some of the wet parts but is nowhere abundant. *Salix Caprea*, Sallow, also occurs but is rare.

Cratægus, Hawthorn, occurs scattered through the wood—both *C. monogyna* and *C. oxyacantha* occur here, the former being more common.

Prunus spinosa, Blackthorn, and *P. insititia*, both occur but chiefly at the edge, where in parts they form a hedge. *P. spinosa* var. *macrocarpa* occurs sparingly.

P. Cerasus, Cherry, is rare but does occur. It is another plant mentioned by West * as probably extinct.

Other shrubs are *Cornus sanguinea*, Dogwood, and *Euonymus europæa*, Spindle-tree, both of which occur in considerable quantity as under-shrubs. *Pyrus Malus*, Apple, occurs in small quantity as a shrub.

Viburnum Lantana, Wayfaring Tree, *V. Opulus*, Guelder Rose, and *Ligustrum vulgare*, Privet, are locally abundant, especially the last named. *Sambucus nigra*, Elder, is rare. *Rubus* spp. (especially *R. cæsius*) and *Rosa* spp. (especially *R. arvensis*) occur in considerable quantity locally ; they will be considered along with the ground flora.

Rubus Idæus. A few bushes occur in the wood. White Wood, Gamlingay, on Greensand, was previously the only record of this plant in West Cambridgeshire †. It has recently been noticed in another *Ash-Oak* wood in S.E. Cambridgeshire, on the Boulder Clay.

A "pseudo-shrub" growth of *Ulmus* and to a less extent of *Populus tremula* is produced in parts after the cutting of the shrub layer by extensive suckering.

The principal shrubs—*Hazel* and *Ash*—appear to be in a quite natural condition, except for the periodic cutting. There is no direct evidence of the planting of shrubs or trees, and none occur that can be considered as alien to the habitat. The distances between the shrubs show no more regularity than would be expected in such a dense growth. On the other hand, in one or two small isolated areas in the wood the *Ash* and *Hazel* shrubs are arranged in roughly alternating rows, with sufficient regularity in the limited area to suggest the work of man. Over much the greater part of the wood there is no evidence of this sort. Assuming that at some time *Hazel* and *Ash* have been planted, they would seem to have been put in to replace others of the same species.

Climbers are not abundant. *Lonicera Periclymenum* is the most so, especially on the loam, though not confined to that part.

Hedera Helix occurs near the edges, climbing some of the trees, but does not creep over the ground.

Other climbers are *Tamus communis* and *Bryonia dioica* ; the last named is confined to the edges. Both are confined to the clay.

* West, 1898, p. 247. † Babington, 1860, p. 73.

The Ground Flora.

The floras on the two types of soil are so markedly different that they will be considered separately.

Ground Flora of the Calcareous Clay.

The ground flora of this part can be divided into three more or less sharply defined societies * depending on various factors. These three societies are dominated respectively by *Spiræa Ulmaria*, by *Spiræa Ulmaria* and *Deschampsia cæspitosa*, and by *Mercurialis perennis*. Subdivisions and intermediate societies occur, but are of secondary importance. The main factors determining the boundaries of these societies are soil-moisture and light, but, except perhaps in the case of the *Mercurialis perennis* Society, which is drier at all times, neither factor is sufficient by itself to cause the differentiation.

Light.—The amount of light admitted by the shrubs in different stages of their growth is extremely varied and has a very marked effect on the vegetation. This, however, is probably not all due to the effect of light alone; in all places where the light is reduced shelter occurs, and the amount of this is roughly proportional to the reduction of the light. This shelter causes a reduced rate of evaporation and consequently of transpiration due to the stillness of the air and increased relative humidity. This fact, which cannot well be separated from the light, certainly has considerable effect; but at present it is impossible to say how much of the observed effect is due to either factor singly.

Estimations of the light † ‡ were made by means of a photographic actinometer with sensitive paper. This method seems the most convenient for general use, but has the drawback that it measures mainly the actinic rays, while those used most by plants are towards the other end of the spectrum, and it gives a momentary measure not a light-sum. No other method, however, seemed practicable at the time. A standard test for the sensitive paper was arbitrarily fixed and the times of reaching this both in the open and in different parts of the wood were noted. No records of the absolute light-intensity † § were made; the figures given are relative light-intensities in terms of the intensity of the light in the open at the time.

Great differences occur in the amount of light penetrating into the wood, both according to the season and more especially with regard to the growth of the shrub layer. The light penetrating the trees varies according to the species and to their density. Oak and Aspen cut off comparatively little, the relative intensity among them being about 0·4 to 0·3; while with shady trees, such as *Acer campestre*, the amount is reduced to 0·3 to 0·2. The trees

* Clements, 1905, p. 296.

† Wiesner, 1907; also Blackman, 1907, p. 273.

‡ Woodhead, 1906, p. 337.

§ Clements, 1905, p. 56.

in the wood, however, never form a close canopy but are more or less widely separated. The areas between appear to the eye to have the full intensity of light, but measurements revealed the fact that the intensity was only about 0·8 to 0·75, owing to the cutting off of some of the diffuse light. And in parts where there are no shrubs and no cover from trees the effect is still more noticed, the intensity just above the ground flora being only about 0·6.

The shrubs being cut periodically have a varied effect in cutting off light from the ground flora. They take about 6 to 8 years to form a close canopy, and during this period a certain amount of direct sunlight can penetrate to the ground flora, though the intermediate parts have much reduced light-intensity, about 0·06. At about 9 to 11 years the average light-intensity above the ground flora is about 0·07 to 0·03, while when the shrubs are full-grown little or no direct sunlight can penetrate and the diffuse light is very much cut off; the intensity here is as little as 0·01 and may descend still lower. All intermediate intensities occur in different parts.

These figures are all based on estimations made during the summer, when the full foliage is developed. Earlier in the year in the prevernal and vernal aspect * the relative amount of light penetrating is much greater.

The variations of the ground flora with the intensities of the light will be discussed later, but some special cases may be mentioned here. In general, when the light-intensity is very much reduced, the plants do not flower; or if they do, in much less quantity and later in the season. For example, *Spiræa Ulmaria* in sub-open conditions commences flowering about the end of June; but under deep shade it produces much fewer flowers, which do not open till the latter half of July. Some species are very intolerant of reduced light, notably the larger Gramineæ. Two other plants occurring in the wood may be mentioned here as rather extreme cases of intolerance—*Hyperium hirsutum* and *Campanula Trachelium*. Both are abundant in light parts, but the former does not flourish when the light is less than 0·2 and hardly flowers at all with less than 0·3. *Campanula Trachelium* will stand greater shading, but it never occurs in less than 0·08.

Evaporation.—As mentioned above, the effects of this factor are closely united with those of light; the factors producing a reduction of the one causes at the same time a reduction of the other.

Experiments have been carried out to measure the rate of evaporation in different parts of the wood. The instruments used for this purpose were of the same pattern as those employed by Professor Yapp in his experiments on Wicken Fen †. I desire to take this opportunity of expressing my thanks to him for his kindness and trouble in getting the evaporimeters made for me, and also for his valuable advice as to methods of experimentation.

* Clements, 1905, p. 315. † Yapp, 1909, p. 285.

To obtain a record of the variations of evaporation throughout the growing season a permanent set of instruments was set up near the centre of the wood. The shrubs in this part were not quite half-grown, being about 8 ft. high, and just about to form a closed canopy. The ground flora was mainly *Spiræa Ulmaria*. A vertical series of evaporimeters was arranged, the top one, E_1, being just clear of the shrub layer; the second, E_2, was put at the level of the densest shrub foliage; while the third, E_3, was at the summit level of the ground flora. It was not found practicable at first to have a permanent instrument on the ground, owing to the herbage getting trampled down all round, and artificial conditions so produced. A fourth permanent instrument, E_4, was placed in another part, just clear of the ground flora; here the wood was fairly open, there being no shrubs or trees within several yards.

For the season these instruments gave the following results for evaporations for intervals of a week, measured in cubic centimetres:—

Week ending	E_1.	E_2.	E_3.	E_4.
Feb. 21	..	..	..	123 * †
Mar. 1	54			
Mar. 11	88	98	78	
Mar. 15	42	45		
Apr. 20	86	60		
Apr. 27	147	122	126	145
May 4	141	112	115	124
May 11	104	129	124	145
May 18	182	149	142	176
May 25	177	147	140	166
June 1	125	108	107	134
June 8	141	91	93	123
June 15	114	66	72	91
June 22	167	..	131	159
Aug. 17	121	89	62	

These figures show a maximum of evaporation for a week occurring about the middle of May; this is before the full foliage of the summer is formed, and although the top instrument, E_1, may later reach figures almost as great, the others never do.

In this wood the rate of evaporation does not rise evenly with the height above the ground, as might have been expected ‡. Thus, E_2 frequently gives smaller rates of evaporation than E_3, owing to the fact that the stratification of the vegetation is uneven; and E_3 comes between two layers, and, consequently, is rather more exposed than E_2, which is in the midst of the second

* Corrected readings after calibration on methods suggested by Yapp, 1909, p. 311.

† Fractions are here omitted. ‡ *Cf.* Yapp, 1909, p. 291.

layer. The reason for E_4 rising above E_1 for the week ending June 1 is that the instruments were exposed then to driving rain, and E_1, being more exposed, collected more on the evaporating surface; the figures in this case probably do not represent the total evaporation possible.

In the later parts of the year an instrument was placed on the ground near the permanent station. This gave very much smaller readings than any of the others, though its rates follow the same general curve.

The total evaporation during the growing season works out in the following proportion, E_1 being taken as a standard :—

$$E_1 : E_2 : E_3 : E_4 = 100 : 75{\cdot}6 : 80{\cdot}4 : 93{\cdot}5.$$

Evaporation experiments have also been carried out in other parts of the wood to obtain the rates under different conditions. The effect of the closed canopy of shrubs is very marked; for a period of 6 days the results of evaporation in deep shade, and before the closing of the canopy, were :—

	A. Open Shrubs.	B. Closed Canopy.
Above ground flora	62	36·5
On ground..................	16·8	13·5

The small difference on the ground is due to the fact that the absence of cover is partially counterbalanced by the much denser growth of the ground herbs. The direct effect of the shrubs is shown in the other readings, where the value under the closed canopy is reduced to nearly a half.

The variations of these two sets for short periods are also interesting. The curves for the instruments in deep shade, for intervals of two hours, are practically parallel, whereas in the other pair the raised one shows sharp changes with changes of the climatic conditions, while that on the ground changes much more gradually. A noticeable feature of difference in these two sets is the rate at night. This falls very low upon the ground.

This drop, however, in both instruments is greater in those in the open position, so much so that these give a lower value at night. The amounts for the night August 13–14, 1909, for a period of 16 hours, were :—

	A. Open.	B. Shade.
Raised..............	5 2	5·25
On ground	2·1	2·4

In general, the curve of evaporation on the ground follows the same usual trend as that at higher levels, but does not show the small temporary changes to nearly the same extent. Evaporation follows the changes in

relative humidity very closely, though the changes in evaporation are often much greater for a small humidity change than would be expected; the maxima and minima often slightly lag behind those of the relative humidity.

Apart from the changes mentioned above, due to the shrub-growth, the rates of evaporation are different in the different societies. The ground rate is greatest in the *Mercurialis* Society and least in the *Spiræa-Ulmaria* Society The *Spiræa-Deschampsia* Society has a rather higher rate than the *Spiræa* Society, but less than the *Mercurialis* Society. Figures for these societies obtained in positions of practically equal shrub-growth, work out in the proportion of:—

Mercurialis Soc.	:	*Spiræa-Deschampsia* Soc.	:	*Spiræa* Soc.
= 100	:	87	:	84·5

This difference is due, at any rate partially, to the much less dense and deep character of the ground vegetation in the *Mercurialis* Society. In the early part of the year the difference is much less, and owing to the persistent tufts that of the *Spiræa-Deschampsia* Society may be least.

With regard to the absolute rates of evaporation a direct comparison cannot be made with the figures of Yapp* or Livingston†, as none of my instruments was free from the shelter of the trees. It was not found practicable to raise an instrument above the tree level. However, some idea of this protection can be obtained by comparing the evaporation rates of E_1, which had only the protection of the trees, with Yapp's instrument, which was free from the vegetation. Thus the average rate for 24 hours of E_1 was: during May, 22·7 c.c.; June, 22·9 c.c.; August, 20·4 c.c.; or, in linear evaporation: May, 0·110 cm. (0·043 ins.); June, 0·111 cm. (0·044 ins.); August 0·099 cm. (0·039 ins.). Yapp's A*, which was clear of vegetation, during August 1908 gave an average of 53·2 c.c. for 24 hours. The relative evaporation would be: A : E_1 = 100 : 42·6 : 43·04 : 32·7 for May, June, and August respectively. This would show a protective action of the trees of 60 per cent. of the evaporation, and as the relative humidity is probably greater in the Fen than here the actual reduction may be still greater.

The readings for ground evaporation may be compared with those given by Transeau‡ for forest associations in Michigan. Considerable similarity apparently exists. Transeau's Station 6, a deciduous forest with a decided shrub-layer, gave a daily average of 8·48 c.c., while 7 c.c. was obtained in this wood in an open part of the ground flora; Transeau's "Swamp Forest" gave 2·28 c.c., as compared with 2·58 c.c. for the *Spiræa-Deschampsia* Society. The figures for the *Spiræa* Society under deep shade, 1·75 c.c., are smaller than any given by Transeau for forests. However, as Transeau does not

* Yapp, 1909, p. 295. † Livingston, 1906, p. 29. ‡ Transeau, 1908, p. 224.

mention whether his figures are corrected, or simply the total evaporimeter loss, which would be about 1·5 times as great *, this comparison cannot be pushed too far. Yapp's C (on the ground) averaged 5·85 c.c. per day during August, 1908, which is considerably more than the rate in the wood when the ground vegetation is at all dense.

The greatest amount of evaporation recorded in the wood for a period of 24 hours was 32·06 c.c., or in linear evaporation 0·156 cm. (0·06 in.), given by E_1 on May 10–11, 1910, under conditions suitable to high evaporation; sunshine, with a moderate wind and rather low relative humidity, 55–59.

The greatest reading for 1 hour took place from E_1 on April 27, 1910, when 6·26 c.c. (0·3 cm., 0·01 in.) was evaporated between 12 noon and 1 o'clock P.M. This was before the appearance of the leaves, at a temperature of 16° C. and relative humidity 51. This relative humidity is extremely low for this part; during the summer readings rarely fall below 55, and average over 60.

Soil-moisture.—This is the other important factor influencing the distribution of the plant societies.

In general, when the evaporation rate at the surface is low and the humidity high, the soil during a period of drought loses more water than with quick evaporation, and dries evenly to considerable depths †. On the other hand, where the evaporation is very rapid an air-dry layer is formed on the surface, corresponding to the "dust mulch" of agriculturists ‡ §. This dry layer prevents loss of water to the same extent in the deeper layers †. This may partly explain the reasons for the drop in the soil-moisture curves in the summer, when the precipitation is greater. As mentioned above ‖, the increase in precipitation is to some extent counterbalanced by its being more concentrated and by the much lower humidity.

All the calcareous clay soils are very wet in winter, never falling much below 40 per cent. The soil of the *Mercurialis perennis* Society is always drier than the others. It falls steadily from a winter average of 44 per cent. till May, when it averages 27 per cent. A slight rise occurs in the end of May and the beginning of June, after which there is a steady falling to the average minimum, in July, of about 24 per cent.; locally it may get much drier, falling to about 18 per cent. The reason for the lower water-content of this part is mainly drainage. This society is developed in the S.E. end of the wood, where the ground slopes off, and in raised parts elsewhere where ditches have been cut.

The other two societies show more varied water-contents. The *Spiræa Ulmaria* Society has a marked rise in June to about 43 per cent., and this falls off to about 32 per cent., occasionally rising to as much as 50 per cent. in

* Yapp, 1909, p. 295.
† Livingston, 1906, p. 34.
‡ Hall, 1908, p. 102.
§ Lyon & Fippin, 1909, p. 195.
‖ *Cf.* under "Rainfall."

August. The minimum occurs in May—30 per cent. This soil dries very evenly to considerable depths; but, owing to its high water-holding capacity, never gets very dry.

In general, the soil of the *Spiræa-Deschampsia* Society has very much the same water-content as the *Spiræa* Society; it is usually slightly lower, but has a higher minimum—32 per cent.—and is more rapidly variable in summer.

Another factor that seems to influence the variations in soil-moisture between the last two societies, as compared with the *Mercurialis* Society, is that in them there is often a layer of mosses on the surface, which is practically absent from the latter.

Details of the Plant Societies.

Calcareous Clay.

I. *Spiræa Ulmaria* Society.
II. *Spiræa Ulmaria* and *Deschampsia cæspitosa* Society.
III. *Mercurialis perennis* Society.
IV. *Fragaria vesca* Society.

Loam.

I. *Pteris aquilina* and *Holcus mollis* Society.
II. *Holcus mollis* Society.

Plant Societies of the Calcareous Clay.

I. *Spiræa Ulmaria* Society.

This society falls into two divisions, depending mainly on the amount of light.

Spiræa Ulmaria Society. (*a*) Shade Form.

Where the shrubs are nearing the end of their rotation the ground flora is much less dense than where more light penetrates. In such situations the ground flora is usually dominated by *Spiræa Ulmaria*, associated with several other plants, such as :—

Primula elatior	a *	*Carex sylvatica*	o
P. vulgaris	la	*Nepeta hederacea*	la
Anemone nemorosa.........	o–a	*Angelica sylvestris*	o
Scilla nonscripta...........	lo		

* The following signs are used to indicate the relative abundance :—d, dominant; s, subdominant; a, abundant; o, occasional; r, rare; vr, very rare; l, local; la, locally abundant; lo, local, but occasional.

Also present in considerable quantity are :—

Ranunculus Ficaria	o	*Stachys officinalis*	o
Viola Riviniana	o	*Rumex viridis*	o
V. sylvestris	o	*Orchis mascula*	o
Fragaria vesca	o–a	*Habenaria virescens*	r
Rubus cæsius (small plants)	o	*Listera ovata*	o
Cnicus palustris	o	*Luzula pilosa*	o
Ajuga reptans	o		

And locally small plants of :—

Deschampsia cæspitosa ... } r
Poa trivialis .... }

Mosses * are fairly abundant in this society, especially :—

Thuidium tamariscinum †	a	*Brachythecium rutabulum*	o
Hylocomium triquetrum	a	*B. velutinum*	o
Hypnum cupressiforme (especially on trees).	a	*Mnium undulatum*	r

The average light-value here for the summer months is 0·03–0·01, or even less. Owing to this small intensity the *Spiræa* does not flower except along the paths and in more open parts. In a few parts of this society the light is still further reduced, 0·01–0·005 ; here *Spiræa* is thinly scattered or absent locally. *Anemone nemorosa*, *Primula elatior*, and, locally, *Scilla nonscripta* form the principal covering.

These are species in which the active period comes on early, before the full foliage is out on the trees and shrubs ; in this part in summer the ground may be almost bare, except for the Oxlip leaves and the yellow dying leaves of *Anemone* and *Scilla* with the mosses.

The normal shade *Spiræa* Society has a high water-content for the soil. The annual mean is 47 per cent., with a range from 90–33 per cent. It very exceptionally rises above 60 per cent., except when the water-table rises above the surface ; the summer average is about 40 per cent. The very shaded parts where *Anemone nemorosa* becomes prominent are rather drier, averaging 35 per cent. in the summer.

A quadrat ‡ was laid down in a typical part of this society to show, among other things, the seasonal changes or aspects. In spring *Spiræa* is not very important. The dominating plants are *Primula elatior*, *Anemone*, and *Viola Riviniana* with *V. sylvestris*. Later in the year the *Spiræa* forms an almost pure covering, with Oxlip tufts at intervals. Mosses become dominant in winter.

* Watson, 1909. † The nomenclature is that of Dixon & Jameson's Handbook, ed. 2, 1904.
‡ Clements, 1905, p. 162.

The roots of *Spiræa* occupy slightly deeper layers on the soil than those of *Viola*, *Nepeta*, &c., but about the same as those of the Oxlip: with the former it forms a "complementary" society *, both seasonably and edaphically, while with the latter the society is edaphically "competitive" *.

In the greater part of this society the *Oxlip* is the only representative of the genus *Primula*, but in other parts *P. vulgaris* may be present in addition to, or to the exclusion of, *P. elatior*. This point is of interest in connection with what Miller Christy says of the distribution of the two forms:—"Notwithstanding the immense abundance of the Primrose all round the Oxlip area, I have never detected a single plant growing within that area except on or close to the margin" †. In Gamlingay Wood the two species for the most part occupy separate areas, but with wide margins, comprising both species and numerous hybrids. But in several parts of the wood, of considerable extent, a mixture of the two species occurs ‡. Some of these are surrounded by areas of almost pure Oxlip, without a Primrose region being immediately at hand. On the other hand, the whole of Gamlingay Wood is on the extreme edge of the Oxlip area as defined by Christy †, where a complication of distribution might be expected.

In other *Ash-Oak* woods in the district a similar mixing of the two species occurs in Eversden Wood; but in Hayley Wood and also in Kingston Wood *Primula elatior* occurs alone. On the other hand, in Borley Wood, on Boulder Clay above Chalk in South Cambridgeshire, *Primula elatior* is quite absent.

Spiræa Ulmaria Society. (*b*) Open Type §.

Another *Spiræa* Society occurs in other parts of the wood, where the light is rather less reduced than in the type described. In this *Viola*, *Anemone*, and *Ranunculus Ficaria* are much less abundant. The "prevernal aspect" ‖ is controlled by *Primula elatior*, often extremely abundant, *Ajuga reptans*, and *Nepeta hederacea*. Later in the year *Spiræa Ulmaria* forms an extremely dense growth, much more so than in the Shade Society. It is often almost pure, but mixed with it is usually some *Angelica sylvestris*, *Cnicus palustris*, and *Rumex viridis*, the first-named being locally extremely abundant. This is hardly a separate society, but only a light variation of the former one. The water-content shows a slightly higher summer average, 43 per cent.

In these *Spiræa* Societies there are local patches, not usually very large, in hollows, &c., where the water-content never falls below 40 per cent., and

* Woodhead, 1906, p. 345.

† M. Christy, 1897, p. 192.

‡ Adamson, 1910.

§ The term "open" is here used to express a less degree of shade, in opposition to the "shade" type of society.

‖ Clements, 1905, p. 321.

remains nearly saturated all through the year; the summer average is 50–55 per cent. Here *Spiræa* is still the dominant form, but is associated with different species, such as :—

Carex riparia	s
C. acutiformis	r
C. vulpina	a
C. vulpina var. *nemorosa* .	r
C. remota	o

Besides these *Carices* other abundant species are :—

Juncus effusus	o	*Angelica sylvestris*	o
J. glaucus	o	*Lythrum Salicaria*	o to la according to light.
J. lamprocarpus	r	*Lychnis Flos-cuculi*	o
Cnicus palustris	o		

Juncus bufonius and *Callitriche stagnalis* occur in this part in open spots, such as paths, &c. Oxlips, in common with most of the smaller herbs, are here rare or absent, but *Primula vulgaris* may occur.

Eurynchium prælongum is the principal moss in this part.

II. *Spiræa Ulmaria* and *Deschampsia cæspitosa* Society.

This society is separated chiefly for convenience of description from the foregoing. The main difference is in the light-intensity, which is greater than in the *Spiræa Ulmaria* Society; in shady parts it is 0·03–0·06 and up to 0·6 in others.

Spiræa Ulmaria is still the dominant plant, but becomes associated with numerous others that are intolerant of deep shade. This society can be divided into several sub-societies, depending on the degrees of light and soil-moisture.

When the light is not more than 0·05 *Spiræa* is solely dominant, and all stages can be found between this and the co-dominance of the species, which occurs at about 0·2 light-intensity.

In this society other very abundant species are :—

Cnicus palustris	o–a
Angelica sylvestris	o
Primula elatior	a
P. vulgaris	la
P. elatior × vulgaris.........	la
Carex sylvatica	o

Other commonly occurring species are :—

Anemone nemorosa	o	*Campanula Trachelium* ... where light sufficient.	lo
Ranunculus Ficaria	o	*Scrophularia nodosa*	r
Viola Riviniana	o	*Nepeta hederacea*	o
V. sylvestris	o	*Ajuga reptans*	o
Geum urbanum	o	*Valeriana officinalis*	l
Fragaria vesca	o–a	*Rumex viridis*	o
Potentilla sterilis	o	*Orchis mascula*	o
Rubus cæsius	la	*Habenaria virescens*	r
Rosa arvensis	a	*Paris quadrifolia*	o
Epilobium montanum	o	*Agrostis vulgaris*	lo
Pimpinella magna	o	*Calamagrostis Epigeios*	vr
Arctium nemorosum	o	*C. lanceolata*	r
A. minus	o		

Mosses are less abundant than in the *Spiræa Ulmaria* Society, chiefly owing to the ground being more occupied.

The most abundant are :—

Fissidens taxifolius	o	*Brachythecium velutinum*	o
Barbula fallax	o	*Eurynchium prælongum*	o
B. unguiculata	o	*Hypnum cupressiforme*	o
Mnium undulatum	a	*H. molluscum*	r
Thuidium tamariscinum	o	*Hylocomium triquetrum*	o
Brachythecium rutabulum	a		

This society has an average summer water-content of 39 per cent. The growth in summer rises to a height of 3–5 feet. Occasionally *Deschampsia cæspitosa* is almost absent with similar light and water conditions. The associates are the same.

As in the *Spiræa Ulmaria* Society so here, there are hollows with a much more marshy vegetation; these parts have a high water-content, averaging 43 per cent. in summer.

Deschampsia cæspitosa is rather less prominent, *Rubus cæsius* is more so, and, with the *Spiræa Ulmaria*, there are in addition :—

Juncus effusus	la	*Lysimachia Nummularia*...	o
J. glaucus	la	*Phalaris arundinacea*	r
Carex riparia	o	*Phragmites communis*	vr
C. remota	la	*Calamagrostis lanceolata*...	o
C. vulpina	o	*C. Epigeios*	r
C. pallescens	o	*Catharinea undulata* ...... (in open parts).	o
Lychnis Flos-cuculi	a	*Fissidens taxifolius*	o
Hypericum tetrapterum ...	r	*Barbula fallax*..............	a
Lotus uliginosus	o	*Mnium undulatum*	a
Epilobium hirsutum	o	*Eurhynchium praelongum*...	o
E. parviflorum	o		
Lythrum Salicaria........	r		

Almost the only Hepatics found in the wood occur here: *Pellia* sp. and a few foliose forms.

Most of the plants of the normal society occur here, with some exceptions: *Paris quadrifolia*, *Geum urbanum*, *Campanula Trachelium*, &c.

Deschampsia caespitosa Dry Sub-Society.

Where the light is stronger *Deschampsia caespitosa* becomes still more prominent locally, to the exclusion of the *Spiraea*. The principal associates in this society are :—

Primula elatior ...	a	with sometimes *P. vulgaris* and hybrids.
Fragaria vesca ...	a	
Rubus caesius	la	
Cnicus palustris...	o	

Hypericum hirsutum may be very abundant, but does not flourish where the light-intensity is less than 0·2. Other species commonly occurring here are :—

Viola Riviniana	o	*Carex sylvatica*	o
V. sylvestris..................	o	*C. pallescens*	o
V. hirta	l	*C. flacca*	r
Lychnis Flos-cuculi	lo	*C. remota*....................	r
Circaea lutetiana	r	*Poa trivialis*.................	o
Campanula Trachelium ...	o	*P. nemoralis*	r
Centaurium umbellatum ...	o	*Anthoxanthum odoratum*...	o
Ajuga reptans	o–a	*Milium effusum*	vr
Stachys officinalis	o	*Brachypodium sylvaticum*.. (in open parts).	lo
Rumex viridis	o	*Bromus ramosus* .... (in open parts).	lo
Epilobium montanum	o	*Mnium undulatum*	la
Orchis mascula	o		
O. maculata	r		
Paris quadrifolia...........	o		

The shade-loving mosses—e. g. *Hylocomium triquetrum* and *Thuidium tamariscinum*—are almost absent here.

The summer water-content in this part is very variable, 37–45 per cent. Parts have a moderate degree of shade and a thick covering of vegetation, and here the summer water-content is 40–45 per cent.; but where the light is greater, or the flora more mixed, the amount is 37–39 per cent. There is no hard-and-fast line between these two extremes, but all gradations occur, irregularly arranged, in the society. *Rubus cæsius* is often very abundant, or forms a transition to the *Rubus cæsius* sub-society.

Sub-Society of Mixed Grasses.

This only occurs in recently coppiced areas where the shade is from the trees alone. The grasses here become still more prominent. *Deschampsia cæspitosa* is sometimes pure locally, but more often is mixed with others, especially :—

Bromus ramosus	a
Brachypodium sylvaticum	a
Festuca gigantea	la

The growth of these may reach a considerable height, so that in the later periods of the year all the smaller species are crowded out. In this case the grasses are associated with such tall-growing species as :—

Dipsacus sylvestris	o–la	*Epilobium hirsutum*	lo
Cnicus palustris	a	*E. parviflorum*	o
Campanula Trachelium	o	*Picris hieracioides*	r
Valeriana officinalis	la		

Rubus cæsius is sometimes very abundant. *Spiræa* is here usually confined to isolated pure patches. This sub-society has a quite different vernal and prevernal aspect before the dense growth of the grasses appears.

The chief species occurring here are :—

Primula elatior	a	*Myosotis umbrosa*	a
P. vulgaris	la	*Geum urbanum*	a
P. veris	r	*Fragaria vesca*	o
Viola Riviniana	a	*Lamium Galeobdolon*	r
V. sylvestris	o	*Prunella vulgaris*	o

Rubus cæsius Sub-Society.

This has slightly less illumination than the typical *Spiræa Ulmaria-Deschampsia cæspitosa* Society, and has a lower water-content, falling in summer to 30 per cent. There is, however, no sharp line of demarcation between this and the other sub-societies, which shade into one another at all points, but in

its extreme form this sub-society is very distinct. *Rubus*, mainly *R. cæsius*, may form such a dense tangle of shoots as practically to exclude all other species except a few spring flowers, such as *Viola Riviniana, Orchis mascula, Primula elatior*, which, however, are not numerous. This tangle of *Rubus* shoots is usually mixed with some other woody plants, as *Rosa arvensis, R. dumalis, R. lutetiana*, and other species of *Rubus* and *Rosa*. Mixed with these are some *Spiræa Ulmaria* and such tall plants as *Cnicus palustris, Angelica sylvestris*, and *Epilobium* sp. Other plants occurring here are:

Vicia sepium ... o, *Lathyrus pratensis* ... o, *L. sylvestris* ... vr,

which climb over the tangled shoots. This is the extreme case of this Society. At other times it passes gradually into the *Spiræa Ulmaria* Society on the increase of shade and moisture; or to the *Spiræa Ulmaria-Deschampsia cæspitosa* Society, by the coming in of *Deschampsia cæspitosa* in greater quantity with the associated plants noted above.

Spiræa Ulmaria and *Rumex viridis* Sub-Society.

In one part of the wood a local variation or sub-society occurs. Near the edge of the wood a *Spiræa Ulmaria-Deschampsia cæspitosa* Society undergoes a change by the diminution of the grass and the appearance of *Rumex viridis* in very large quantity with *Spiræa Ulmaria*. Associated with these are, among others:—

Campanula Trachelium	o–a
Epilobium parviflorum	o
E. montanum	o–a
E. tetragonum	lo
Poa trivialis	o
Anthoxanthum odoratum	o
Carduus crispus	lo

This sub-society is of very limited extent, and, perhaps, not much more than a *Rumex* community * in the other society.

These various societies with *Spiræa Ulmaria* cover more than three-fourths of the calcareous clay area of the wood. The rest of this region is covered by two main types of ground flora—the one dominated by *Mercurialis perennis;* and a mixed transition type which may be referred to as the *Fragaria vesca* Society, as that is the most abundant species in most parts of it.

III. *Mercurialis perennis* Society.

This is in sharp contrast to those previously described. Apart from other factors, the water-content is strikingly different.

* Clements, 1905, p. 297.

It can be divided into two sub-societies—a dry and a damp one.

One feature separating both these from the other societies of the calcareous clay is the depth to which roots extend; in the others even shrub-roots do not penetrate more than about 7 inches, while here the roots of hazel extend to well over a foot.

Mercurialis perennis Society. (1) Dry Type.

This is confined to small areas in the wood, all at or near the edges, along banks beside the boundary ditch especially. In addition, there are isolated patches on mounds in other societies. The maximum water-content here is 38·5 per cent. and the mean annual amount 31·16 per cent., while in the summer it falls to 22–24 per cent. In dry weather in summer the soil may become very hard and crack freely at the surface, when very little water is present in the first 1½ ins., though below the soil is comparatively wet. This condition does not occur in other societies except in open parts, and is correlated with the greater evaporation rate on the ground.

Mercurialis perennis is dominant and is often very nearly pure; prominent among the associates are:—

Fragaria vesca	a
Viola Riviniana	o
Scilla nonscripta	la
Geum urbanum	o

with some others rather less abundant:—

Carex sylvatica	o
Anthoxanthum odoratum	o
Lamium Galeobdolon	lo
Arum maculatum	o
Tamus communis	o
Heracleum Sphondylium	r
Hypericum hirsutum	la

In this Society *Scilla nonscripta* may be very abundant, even showing dominance locally. *Scilla* and *Mercurialis* form a good example of an edaphically "complementary" society *.

Mercurialis perennis Society. (2) Damp Type.

The above society passes directly into the *damp Mercurialis perennis* Society, which has a rather higher percentage of soil-moisture, the summer average being 25–26 per cent. There is no sharp line between these two. In this

* Woodhead, 1906, p. 345.

latter society *Mercurialis perennis* is much more mixed with other forms. *Primula elatior* is abundant.

Other prominent species are :—

Viola Riviniana	a	*Orchis mascula*......	o	
V. sylvestris	o	*Habenaria virescens*	l	
V. hirta	r	*Listera ovata*	o	
Hypericum hirsutum ...	lo	*Scilla nonscripta* ...		less than in the above.
Geum urbanum	o			
Fragaria vesca	a	*Paris quadrifolia*...	o	
Epilobium montanum ...	o	*Arum maculatum* ..	o	
Arctium nemorosum	o	*Carex sylvatica* ...	o	
Nepeta hederacea	la	*Poa trivialis*	r	
Ajuga reptans...	o	*Milium effusum* ...	o	

Locally in this society *Deschampsia cæspitosa* may be mixed with *Mercurialis perennis.* Other plants occurring here are *Rubus cæsius* o, *Rosa arvensis* o, *Rubus Idæus* vr, and *Epilobium angustifolium* * vr.

Spiræa Ulmaria may also occur here locally in small quantity. This *Deschampsia cæspitosa* region forms a direct transition to the *Spiræa Ulmaria-Deschampsia cæspitosa* Society. It has a slightly higher water-content than the typical *Mercurialis* Society. The percentage of water in the Damp *Merculialis* Sub-Society seems to be the lowest with which Oxlips will flourish ; not a single specimen was found in the dry sub-society.

Mosses are not at all abundant in the *Mercurialis* Society and never form a definite layer. The most abundant are :—

Fissidens taxifolius..	r	
Barbula fallax	o	
Mnium undulatum	a	
Brachythecium rutabulum	a	
Hypnum cupressiforme	o	mostly on trees.
H. molluscum	o	

A fourth plant society can be recognised on the calcareous clay, which, though not extensive, is fairly distinct. In many ways it forms a transition between the *Spiræa* Societies on the one hand and the *Mercurialis* Society on the other.

IV. *Fragaria vesca* Society.

The average summer water-content under moderate conditions of shade is about 30 per cent. The light conditions are very much the same as in the

* Not previously recorded for the county. Babington, 1860; Watson, 1883.

Spiræa Ulmaria-Deschampsia cæspitosa Society. It may here be mentioned in reference to the low water-contents of this and the *Mercurialis perennis* Societies that they are almost confined to the southern end of the wood, where the slope of the ground, even though very gentle, causes a better drainage.

This *Fragaria vesca* Society is essentially a mixed one, with its composition altering in different parts. In general the most abundant and important plants are :—

Fragaria vesca	d	*Circæa lutetiana*	l
Geum urbanum	ls	*Nepeta hederacea*	a
Primula elatior (or *P. vulgaris*)	a	*Hypericum hirsutum*	la

Other species in this society are :—

Viola Riviniana	o	*Prunella vulgaris*	o
V. sylvestris	o	*Rumex viridis*	o
Cardamine pratensis	vr	*Orchis mascula*	o
Spiræa Ulmaria	o	*Habenaria virescens*	o
Epilobium montanum	o	*Scilla nonscripta*	la
Sanicula europæa	o	*Paris quadrifolia*	o
Cnicus palustris	o	*Arum maculatum*	o
Centaurium umbellatum	o	*Carex sylvatica*	o
Veronica Chamædrys	o	*Poa trivialis*	lo
Bartsia Odontites	lo	*Anthoxanthum odoratum*	o
Ajuga reptans	la		

Digitalis purpurea vr occurs in one part of this society in small quantity. This plant has usually been regarded as absent altogether from the county of Cambridgeshire * † ‡. It is not mentioned at all in the county flora * or in Watson's Topographical Botany ‡ for the County. It was recently discovered by Dr. Moss and myself, both in this wood and in White Wood, a few miles distant, situated on the Lower Greensand. Both this species and *Epilobium angustifolium* are Greensand plants, and this seems the limit to their eastern range in this wood.

Mercuralis perennis occurs locally as pure patches in this society, but these do not cover any extent of ground. *Deschampsia cæspitosa* is also present in small quantity.

Where the shade is dense *Circæa lutetiana* becomes the dominant form often mixed with a little *Spiræa Ulmaria*, or locally forming nearly pure sheets. After cutting, this species may persist singly for some time, but gradually the others, so to speak, force an entrance and the flora becomes

* Babington, 1860, p. 317. † West, 1898. ‡ Watson, 1883.

more mixed. In this case *Epilobium* spp. and *Angelica sylvestris* often become temporarily very abundant.

This society passes imperceptibly into the other societies by increase or decrease of moisture.

Vegetation of recently Coppiced Areas.

Whatever the vegetation was previous to cutting, great changes take place immediately afterwards owing to the sudden increase of light and of the evaporation rate. Plants from surrounding cornfields and pastures find admission in the sparsely populated soil thus exposed, but apart from these the vegetation becomes very mixed. When the shrubs are just at the end of their rotation the light is so much reduced that the ground flora is very scattered and does not form a continuous carpet. Accordingly, on cutting a suitable nidus is at once ready for species from all the surrounding areas. Grasses tend to become very numerous, the most prominent being: *Deschampsia cæspitosa, Anthoxanthum odoratum, Bromus ramosus, Festuca gigantea, Brachypodium sylvaticum, Poa nemoralis, Poa trivialis, Agrostis vulgaris*, and *Dactylis glomerata. Rubus cæsius* and *Rosa arvensis* likewise spread very quickly from surrounding societies, the former especially often nearly choking out the exising vegetation. Apart from plants of the ordinary societies, the following plants occur which were not noted in other parts of the wood:—*Hypericum perforatum, Epilobium tetragonum, Carduus crispus, Dipsacus sylvestris, Myosotis umbrosa*, and *Leontodon hispidus*. The following species also are much more abundant here than anywhere else in the wood: *Centaurium umbellatum, Epilobium hirsutum, Carex muricata.*

Aquatic and Subaquatic Vegetation.

In the calcareous clay area are several small hollows and ditches which are filled with water either the whole or part of the year. These hollows are to be distinguished from those described, which rarely if ever have free water in them.

Some of these hollows lose their free water in summer except in wet weather, but preserve a saturated soil; other examples remain all through the year as small ponds of 6 in. to 2 ft. depth.

The former will be considered first. All the examples of this type in the wood happened to be in an area recently coppiced at the time of these investigations, so that no data are available as to the effect of deep shading in these localities. Round the hollow in nearly all cases is a zone of *Spiræa Ulmaria* and *Deschampsia cæspitosa* with *Epilobium* spp., *E. hirsutum, E. tetragonum*, and *E. parviflorum* with *Rubus cæsius*. The flora growing on the ooze-like mud varies in different cases. Those which dry up more quickly have such forms as the following:—*Juncus glaucus*,

Hypericum tetrapterum, *Lychnis Flos-cuculi*, with *Juncus lamprocarpus* and *Galium palustre* in the centre. Others have a thick growth of *Lythrum Salicaria*. In those with more moisture, the zones round the edges have the above species, while in the centre are *Lysimachia Nummularia*, *Ranunculus repens*, and *Galium palustre*, with sometimes also *Callitriche stagnalis*, and *Eurhynchium rusciforme* in one case.

Those with true aquatic vegetation are restricted to two examples. One, the larger and deeper, is in an open area. Round the edge is a dense growth of *Spiræa Ulmaria* and *Angelica sylvestris*, while immediately over the water's edge are *Lysimachia Nummularia*, *Carex remota*, *C. vulpina*, *Juncus lampocarpus*, and *J. effusus*. In the water of this pool, which is about 2 ft. deep in the centre, are large quantities of *Chara* sp., *Ranunculus Drouetii*, *Hypnum aduncum*, and green Algæ. A few plants of *Alisma Plantago* and *Sparganium ramosum* also occur in this pond and also *Glyceria aquatica* (one plant). The second pond is in a deeply-shaded area; the surrounding vegetation is the *Shade Spiræa Ulmaria* Society. In this case there are no fringing plants, but this is probably due to the fact that the banks are very steep. In the water are *Callitriche stagnalis* and *Lemna minor*, with Algæ. The water in these ponds is neutral to test-paper.

Plant Societies of the Loam.

The conditions affecting the ground flora here are rather different from those on the calcareous clay. The shrubs are thinly scattered or absent. This allows a much greater percentage of light to penetrate to the ground flora; in fact, the light at the summit of this is not reduced below 0·3 except immediately below trees and bushes. Correlated with this is a much greater rate of evaporation; the rate here also increases regularly with the height above the ground. The evaporation rate just clear of the ground flora is rather more than E_4 in the permanent series, but not so great as E_1*. The rate on the ground varies with the plants present; when the full growth of *Pteris aquilina* occurs the rate beneath it is very small, the smallest recorded in the wood. But in spring, or when *Pteris* is absent, the rate is greater than in other parts of the wood. Thus for June to July the proportion in a part dominated by *Holcus mollis* was:—

Holcus mollis Soc.	:	*Mercurialis* Soc.	:	*Spiræa* Soc.
= 100	:	85·4	:	72

The figures are for rather open parts on the calcareous clay.

Another difference is the soil-moisture; in winter this is nearly as high a percentage as for the calcareous clay, but it falls steadily through the spring

* See above under "Evaporation."

to about 14 per cent. in July. Correlated with this dryness is the greater rapidity with which the soil warms up in the spring despite its paler colour.

These features, combined with the physical and chemical characters of this soil, produce an entirely different type of vegetation from that on the calcareous clay. The following plants, so characteristic of that soil, are quite absent here *:—

Viola hirta.	*Ligustrum vulgare.*
V. sylvestris.	*Orchis mascula.*
Hypericum hirsutum.	*Habenaria virescens.*
Euonymus europæus.	*Listera ovata.*
Cornus sanguinea.	*Arum maculatum.*
Viburnum 2 spp.	*Carex remota.*
Campanula Trachelium.	*C. glauca.*
Primula elatior.	*C. pallescens.*

The ground flora can be divided into two well-marked societies, a *Pteris aquilina-Holcus mollis* Soc. and a *Holcus mollis* Soc. without *Pteris.*

I. *Pteris aquilina-Holcus mollis* Society †.

This society occupies the largest part of the loam area. The dominant plant in the full summer is *Pteris aquilina*, which forms a thick growth, rising to 3–5 ft. *Holcus mollis* is dominant in the early summer. The principal associates are :—

Anemone nemorosa	a	*Scabiosa Succisa*	o-la
Viola Riviniana	o	*Primula vulgaris*	a
Rubus macrophyllus	o	*Carex pilulifera*	o
Potentilla erecta	o	*C. leporina*	r
P. sterilis	o	*Polytrichum gracile*	a
Fragaria vesca	o	*Catharinea undulata*	o
Lonicera Periclymenum	l	*Mnium undulatum*	o

The principal perennial species are *Anemone nemorosa* and *Primula vulgaris*, as, unlike the society described by Woodhead † for oak woods in Yorkshire, *Scilla nonscripta* is here absent. About June *Holcus mollis* reaches its full development, while later *Pteris aquilina* with its fully expanded fronds crowds and shades out most other species, and is solely and completely dominant. The only plants able to withstand it are strong-growing species such as *Rubi*, e. g. *R. macrophyllus* and *R. silvaticus*, and *Scabiosa Succisa* in more open parts. Except for *Polytrichum gracile*, which forms large pure patches, mosses are not very abundant in this society.

* *Cf.* Moss, 1907, p. 54. † *Cf.* Woodhead, 1906, p. 343.

In some small areas, especially those bordering on the calcareous clay, the soil is much more mixed with clay. Here *Pteris aquilina* is much less abundant and *Holcus mollis* absent; *Calamagrostis lanceolata* becomes the dominant form with

Calamagrostis Epigeios ...	o	*Scabiosa Succisa*	o
Phalaris arundinacea	o	*Potentilla erecta*	o
Deschampsia cæspitosa ...	o	*Stellaria Holostea*...........	r
Angelica sylvestris	o		

Primroses and *Anemone nemorosa* are practically absent. This part has a higher water-content, the minimum reached being 22 per cent.

II. *Holcus mollis* Society.

The differentiating factors between this and the previous society are not very marked. The soil here is rather more sandy and has a lower water-content; this may fall as low as 10 per cent., the summer average being 17–19 per cent., while the *Pteris* Society averages 19–22 per cent.

This society is much more mixed than the previous one; *Holcus mollis* is usually dominant, but locally its place is taken by *Anthoxanthum odoratum*, and transitions occur between these two. The associates in the two extremes are rather different. In the *Anthoxanthum* part this species is solely dominant, associated with

Holcus mollis	o	*Lonicera Periclymenum* ...	la
Luzula pilosa	o	*Angelica sylvestris*	o
L. multiflora f. *congesta* ...	a	*Polytrichum gracile*	
Viola Riviniana	a		

The *Holcus mollis* part of this society is much more extensive and more mixed. Besides *Holcus mollis* the chief species are:—

Anemone nemorosa	o	*Veronica Chamædrys*	o
Ranunculus auricomus......	r	*Nepeta hederacea*	o
R. Ficaria	o	*Prunella vulgaris*............	o
Viola Riviniana	a	*Ajuga reptans*	o
Geum urbanum	a	*Luzula* sp.	r
Potentilla sterilis	o	*L. pilosa*	a
Fragaria vesca	o	*Carex leporina*..............	r
Epilobium angustifolium ...	l	*C. pilulifera*.................	o
Circæa lutetiana	la	*Anthoxanthum odoratum*...	o
Heracleum Sphondylium ...	r	*Catharinea undulata*	o
Angelica sylvestris	a	*Mnium undulatum*	o
Primula vulgaris...........	o		

This society passes gradually into the *Fragaria vesca* Society on the calcareous clay at the point where the two soils unite. *Angelica sylvestris* and *Orchis mascula* are extremely abundant in the transition zone. This part is of varying extent and marked by a mixture of species from the two sides; *Holcus mollis* occurs but is not abundant, *Myosotis umbrosa* and *Carex sylvatica* are abundant. Many of the species do not enter this region at all; thus *Primula elatior* and *Viola sylvestris* are confined to the clay side, and *Luzula* sp. and *Carex pilulifera* to the loam side.

Periodic Changes in the Plant Societies.

A fairly marked periodic change can be made out in some of the societies, especially on the calcareous clay, governed by the periodic cutting and regrowth of the shrubs. For example, the shade type of the *Spiræa Ulmaria* Society may be looked on as a final shade phase. When the shrubs are cut, light and evaporation are suddenly increased. The general result is that numerous outside species enter, and also that the vernal herbs, especially *Primula elatior*, *Ajuga reptans*, *Nepeta hederacea*, and *Carex sylvatica*, suddenly increase in quantity and luxuriance. Numerous species that were quite subsidiary in the shade become prominent, especially *Angelica sylvestris*, *Geum urbanum*, *Epilobium* spp., and *Centaurium umbellatum*. The *Spiræa* at this time gets forced into local pure patches amongst the mixed vegetation.

Also, as mentioned above, grasses, especially *Deschampsia cæspitosa*, come in and grow very rapidly; *Rubus cæsius* also is an early invader by means of its long and rapidly growing trailing shoots.

For the first two or three years the ground flora is very mixed, but as soon as the shade begins to be reformed many of the species become enfeebled and are crowded out by more tolerant forms. As a general rule, the *Spiræa Ulmaria-Deschampsia cæspitosa* Society, or one of its sub-societies, becomes established about the fourth year. Then, by the gradual increase in shade, the *Spiræa Ulmaria* increases at the expense of the others, as it is more tolerant and plastic. *Deschampsia cæspitosa* is very intolerant of deep shade, and even in the shady parts of the *Spiræa Ulmaria-Deschampsia cæspitosa* Society it does not flower much. Thus by the gradual elimination of sun-plants and intolerant species the shade phase is again reached.

Similar transitions can be followed in the *Mercurialis perennis* Society. In this after cutting *Rubus cæsius* tends to overrun the area for a time.

General Notes on the Flora of the Wood.

A complete list of plants found growing in the wood is given as an appendix. The number of aliens it contains is due partly to the cutting, when many plants obtain a temporary footing, and partly to the materials—grain, straw, &c.—brought in in connection with the rearing of pheasants and to invasions along drives and paths.

A general comparison may be made of the flora of the calcareous clay with that given by Moss * for the corresponding woodlands of Somerset; in the trees the chief difference is the great abundance of *Populus tremula* var. *villosa* and the presence of *Ulmus*, neither of which is mentioned as occurring in the "Oak-Hazel" woods of Somerset. However, *Ulmus glabra*, Mill., the species of elm occurring in greatest quantity in this wood, as a native tree is practically confined to the East of England. With regard to the shrubs and ground flora the similarity is remarkable; of the shrubs, no species occurs abundantly in this wood which is not characteristic of similar woods in Somerset, and the similarities of the ground flora are almost equally striking, allowing for such differences as would be expected in two counties with such markedly different climates. Thus *Primula elatior* is confined to the Eastern Counties, while *Aconitum Napellus*, *Lithospermum purpureo-cæruleum*, *Ornithogalum pyrenaicum*, and *Colchicum autumnale*, all characteristic of the Somerset woods, are rare or absent from the East.

In the same way the flora of the loam shows a great similarity to the *Oak Woods* of Somerset *.

Individual Species.

Primula.—The distribution of the two principal species has already been discussed. *P. elatior* and *P. vulgaris* hybridize freely † ‡, and a large number of forms have been found in the wood showing all gradations between the two parents. The Primrose starts flowering earlier than the Oxlip, but reaches its maximum period later and continues longer; the Oxlip flowering season is very restricted. One plant of *P. vulgaris* was found with red flowers, and there was no reason to suppose this was of garden origin; the variety *caulescens* occurs, and also intermediates between this and the type.

Besides these two species, *P. veris* occurs in small quantity near the edges of the wood; hybrids between this and *P. vulgaris* occur, but none were noted with *P. elatior* §. *P. elatior* is the only one of Watson's "Germanic" ‖ type that occurs in this wood.

Epilobium spp.—Five species of *Epilobium* occur—*E. angustifolium*, *E. hirsutum*, *E. parviflorum*, *E. montanum*, and *E. tetragonum*. Of these several peculiar forms were found that in some ways suggest hybrid origin, but few certain hybrids were discovered.

Populus tremula var. *villosa.*—The presence of this tree, which is characteristic of moist soils, on the loam area in a Dry Oak Wood is of interest as being unexpected. The most probable explanation is that the roots are able to reach the bottom water, and that the trees here have come in from the surrounding moist clay soil.

* Moss, 1907, p. 54. † Christy, 1897. ‡ Bailey, 1903.
§ Hill, 1907. ‖ Watson, 1847.

The following species, which might perhaps be expected in an *Ash-Oak* wood of the kind developed here on the calcareous clay, are quite absent:—

- *Lychnis dioica*, apparently quite absent from the county * †.
- *Oxalis Acetosella* is very rare † in the county.
- *Arenaria trinervia*, local in woods in Cambridgeshire, occurs in Borley Wood.
- *Adoxa Moschatellina*, very rare in the county and quite absent from woods, in contrast to Somerset.
- *Asperula odorata*, recorded for the wood by Babington † ; but not found there now, apparently.
- *Monotropa Hypopitys*, found rarely in an Ash-Oak Wood in S.E. Cambs.
- *Lysimachia nemorum*, extinct or misrecorded for the county * ‡.
- *Lithospermum officinale*, found locally in other woods in W. Cambs., *e. g.* Hayley Wood.
- *Melampyrum cristatum* occurs in other Cambridgeshire Boulder Clay Woods, *e. g.* Hayley Wood, usually on the outskirts.
- *M. pratense* is recorded from White Wood, three miles distant †.
- *Daphne Laureola* occurs in Hayley Wood.
- *Euphorbia amygdaloides* occurs in S.E. Cambs.
- *Neottia Nidus-avis* occurs in Waresley Wood, less than three miles distant.
- *Epipactis media*, found locally in other woods in W. Cambs.
- *Allium ursinum* occurs rarely in Hayley Wood and Eversden Wood.
- *Colchicum autumnale*, found rarely in S.E. Cambs.
- *Carex pendula* occurs in woods in S.E. Cambs.
- *Lastræa Filix-mas* occurs sparingly in other woods on the Boulder Clay.

In this wood Pteridophytes are entirely absent from the calcareous clay. This seems probably to be due to the droughts that occur in summer as much as anything else. Pteridophytes, however, are very sparsely represented in the county as a whole.

A similar scarcity in species occurs among the mosses both in this wood and in the county as a whole, as compared with other areas §.

Comparison with other Cambridgeshire Woods.

The area under woodland in the county is very small, smaller than in any other English county ‖ ; but a considerable quantity of what there is, is in a more or less natural condition at the present day.

Excluding plantations, the woodlands are of three kinds:—

* Watson, 1883. † Babington, 1860, p. 190. ‡ West, 1898, p. 247.
§ Watson, 1909. ‖ Hughes, 1909.

1. (*Ash*) *Oak-Hazel* Woods.—This is the dominant kind of woodland on the calcareous Boulder Clay, both on that over Gault or Greensand in Western Cambs., and also on that above the Chalk in the S.E. of the county.

The woods existing at the present day are usually small and rather isolated patches, often occurring on the summits of ridges. There is considerable evidence that adjacent patches, in some cases at any rate, are the last remnants of much larger woodland areas which have been more or less completely cleared for agricultural purposes. That woodland vegetation is the natural type on the intervening land is seen clearly in parts of Western Cambridgeshire, where pastures which have been allowed to run wild for some years are becoming colonized by shrubs, which form a more or less dense scrub ; this scrub is mostly composed of Hawthorns, springing from the surrounding hedges, but in older stages there appear also Hazel, Oak, Maple, and Ash.

All the Ash (Oak-Hazel) woods in the county are periodically coppiced and allowed to regenerate naturally. All of them are of the same general type as the calcareous clay part of Gamlingay Wood.

Those on Boulder Clay over Chalk, as Borley Wood and Balsham Wood, have the drier types of ground society especially developed ; *Mercurialis perennis* here forms extensive pure sheets. On the other hand, in Hayley Wood and Eversden Wood in West Cambs., the wetter *Spiræa Ulmaria* Societies are the most prominent. In Hayley Wood and Kingston Wood, Oxlips occur to the complete exclusion of the Primrose.

2. *Oak* Woods are not very extensively developed in the county ; two of these occur on the Greensand in the Gamlingay district. White Wood has a deep sandy soil ; it is a mixture of *Quercus Robur* and *Q. sessiliflora.* The ground flora is of a drier more healthy type than the dry oak wood part of Gamlingay Wood, with *Deschampsia flexuosa* very prominent. *Great Heath* Wood, also on the Greensand, in so far as it is natural at all, has a very healthy type of flora, with *Calluna vulgaris* and *Deschampsia flexuosa* dominant.

Neither of these woods is of quite the same type as the loam area in Gamlingay Wood.

3. *Beech* Woods, apparently natural, occur in small quantity on the Chalk.

Effect of Environment on the Structure of Plants * † ‡ §.

Some anatomical investigations have been carried out on some of the more abundant species in the wood, from material collected in different conditions of growth, with a view of ascertaining how far structural adaptation was connected with the power of adjustment to a large range of light-intensities.

The two species which show the greatest amount of structural changes are *Circæa lutetiana* and *Rumex viridis*, both of which flourish in light-intensities

* Woodhead, 1906, p. 368. † Stahl, 1880, 1883. ‡ Pick, 1882. § Nordhausen, 1903.

varying from 0·8 to the deepest shade in the wood, about 0·005. *Circæa* shows a greater external difference between the two extremes. In both the mesophyll of the shade-leaf has the cells arranged with their long axes parallel to the surface, with no differentiation into palisade and spongy tissues.

The vernal species, such as *Primula elatior* and *Viola Riviniana*, growing under conditions of very deep shade, show little structural alteration as compared with species growing in open parts, except that the latter are slightly more hairy.

Some of the shrubs show great powers of shade endurance. In *Corylus Avellana* the shade-leaves are much larger and much less hairy, both in leaf and petiole; structurally they show the typical "shade-leaf" arrangement with the palisade cells inclined to the surface and a large intercellular space system.

Acer campestre, which keeps its leaves on the lower branches under conditions of more feeble illumination than does *Corylus*, shows less structural modification, though the extremes are very dissimilar. This species shows very well the arrangement known as "leaf-mosaic" in its shade-shoots; by the twisting of the petioles the leaves are brought to lie at right angles to the direction of greatest incident light, and this is done in such a way that the leaves do not overlap one another.

Another species showing considerable structural modification is *Juncus glaucus*; shoots growing in a light-intensity of 0·04 had a diameter about $1\frac{1}{2}$ times that of shoots in the open. The sclerenchyma was very little developed here.

Viburnum Opulus is a species that will flourish in illuminations as low as 0·05, but yet shows very little difference structurally between the sun and shade forms.

Among species intolerant of light may be mentioned *Fraxinus excelsior*, *Viburnum Lantana*, *Deschampsia cæspitosa*, and *Hypericum hirsutum*.

With the exception of *Deschampsia cæspitosa* none of these flourish when their leaves are more shaded than about 0·1. *Deschampsia* persists in a weak state in intensities as low as 0·03. Here there is very little structural difference; the ridges on the leaf are rather further apart and the whole tuft is lessened in size.

The other species show practically no structural alteration. *Fraxinus* avoids being shaded; by its rapid growth it overtops the hazels and only produces leaves in its upper part.

SUMMARY.

Gamlingay Wood is in a moderately natural state at the present day; all the species growing in it are such as might be expected in a natural woodlan under the same conditions.

It is situated on Boulder Clay, above Gault and Lower Greensand. This

Clay in the wood gives rise to two very distinct soil-types—the one a heavy calcareous clay, the other a non-calcareous loam.

The vegetation of these two soil-types is quite different. The calcareous soil supports an *Ash-Oak Wood* Association, while the non-calcareous loam gives rise to an *Oak Wood* Association. The *Ash-Oak Wood* is the type largely developed on the calcareous clays and marls of Cambridgeshire and the South of England generally. The ground flora of each Association is divided into plant societies, which are controlled mainly by the soil-moisture, the intensity of light, and the rate of evaporation.

The chief societies of the *Ash Oak* Association are dominated by *Spiræa Ulmaria*, either pure or mixed with *Deschampsia cæspitosa*, and by *Mercurialis perennis*. Each society shows several local variations, depending largely on light and changes in soil-moisture.

The societies of the *Oak Wood* Association are dominated by *Holcus mollis* and *Pteris aquilina*, and by *Holcus mollis*.

The main features of the societies are as follows:—

A. *Societies of the Ash Oak* Association.

I. *Spiræa Ulmaria* Society has a range of light-values of ·005–·1 and a high water-content, the summer average being 36–43 per cent.

II. *Spiræa Ulmaria-Deschampsia cæspitosa* Society has a water-content as I., but light ·03–·6.

III. *Mercurialis perennis* Society has a varying quantity of light and a summer water-content of 22–26 per cent.

IV. *Fragaria vesca* Society is intermediate in conditions between II. and III., summer water-content about 3 per cent.

B. *Societies of the Oak Wood* Association.

I. *Pteris aquilina-Holcus mollis* Society has a summer water-content of 19–22 per cent. Soil a heavy loam.

II. *Holcus mollis* Society has a summer water-content of 17–19 per cent. Soil rather more sandy.

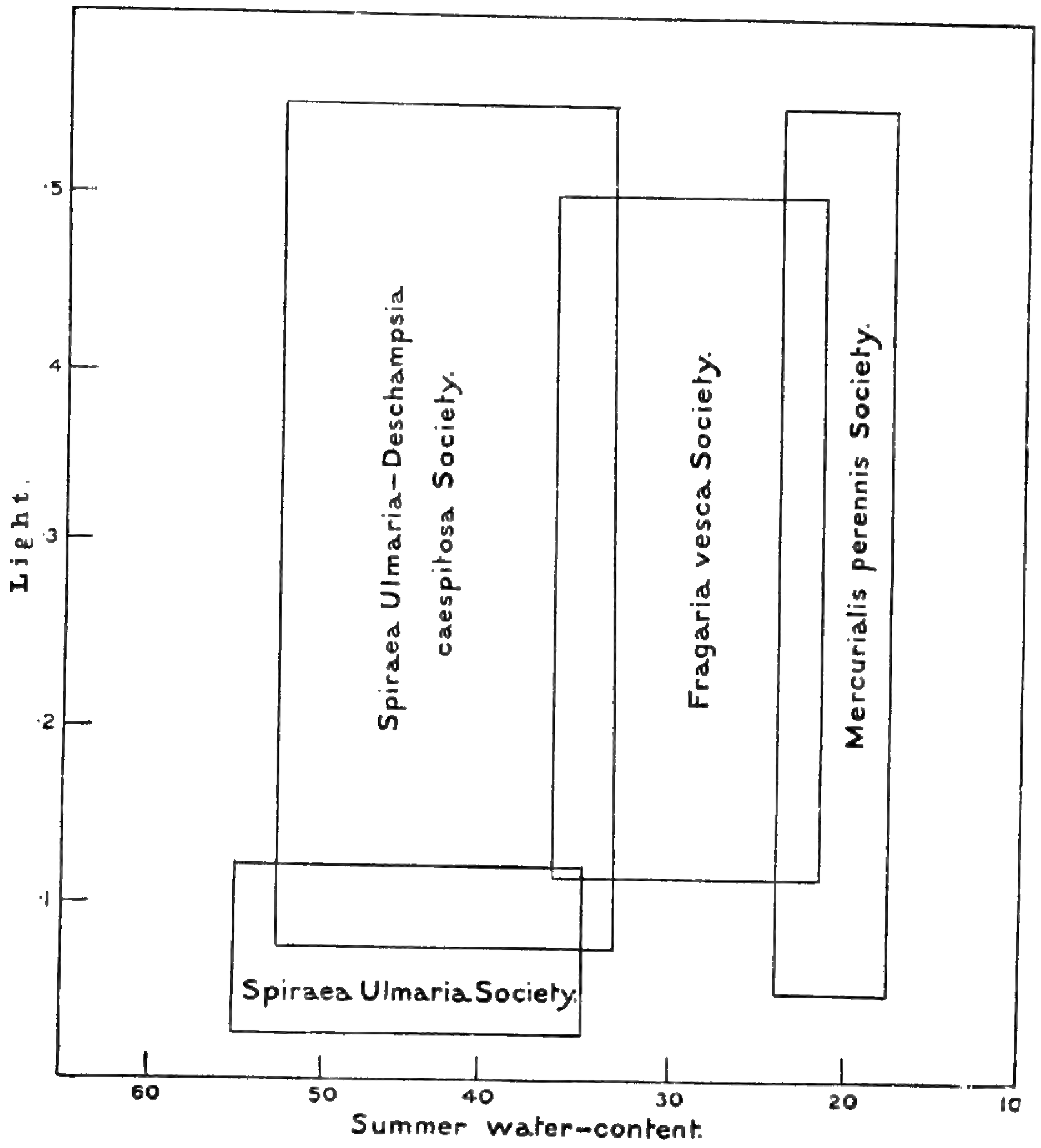
The different Societies of the two Associations pass gradually into one another.

The structure of individual plants is in some cases considerably modified by varying conditions of life. As a rule those that are most modified can withstand a great range of conditions.

In conclusion, I desire to express my very sincere thanks to Dr. C. E. Moss (who originally suggested this investigation to me) and to Mr. A. G. Tansley for their kind help and suggestions during the progress of this study. I have also to thank Professor Seward for obtaining permission for me in the first case and for providing the instruments used in this work.

Appendix A.

The following diagram illustrates the intervelations of the Societies of the calcareous clay to the main determining conditions. The sub-societies are not specially named.



Appendix B.

List of Flowering Plants found in Gamlingay Wood. Those in brackets ( ) are invaders and only found on paths, &c. The signs for relative abundance here refer to the two types of wood as wholes.

The nomenclature is that of the 'London Catalogue,' ed. x. 1908.

	Calc. clay.	Loam.
Ranunculaceæ.		
Anemone nemorosa	o	la
Ranunculus Drouetii	vr	
R. auricomus	r	vr
(R. acris).		
R. repens	r	
(R. bulbosus).		
R. Ficaria	o	r
Papaveraceæ.		
(Papaver Rhœas).		
Cruciferæ.		
(Barbarea vulgaris).		
Cardamine pratensis	vr	
(Sisymbrium Alliaria).		
(Brassica arvensis).		
(Raphanus Raphanistrum).		
Violaceæ.		
Viola hirta	r	
V. sylvestris	o	
V. Riviniana	a	a
× V. sylvestris	r	
Caryophyllaceæ.		
(Lychnis alba).		
L. Flos-cuculi	o	
(Cerastium vulgatum).		
(C. glomeratum).		
Stellaria Holostea	..	r
(S. media).		
(Sagina procumbens).		
Hypericaceæ.		
Hypericum perforatum	r	
H. quadrangulum	r	vr
H. hirsutum	la	
Geraniaceæ.		
(Geranium pusillum).		
(G. dissectum).		
G. Robertianum	r	
Celastraceæ.		
Euonymus europæus	o	
Aceraceæ.		
Acer campestre	a	
var. leiocarpon	o	
Leguminosæ.		
(Medicago lupulina).		
(Melilotus altissima).		
Trifolium pratense	r	
(T. dubium).		
Lotus uliginosus	o	
(Vicia hirsuta).		
(V. tetrasperma).		
(V. gracilis).		
V. Cracca	r	
V. sepium	o	
Lathyrus pratensis	r	
L. sylvestris	vr	
Rosaceæ.		
Prunus spinosa	o	
var. macrocarpa	r	
P. insititia	r	
P. Cerasus	vr	
Spiræa Ulmaria	ls	
Rubus Idæus	vr	
R. silvaticus	..	r
R. macrophyllus	..	o
R. corylifolius.		
R. cæsius	a	
R. spp.	r	
Geum urbanum	a	o
Fragaria vesca	a	a
Potentilla sterilis	o	a
P. erecta	lo	o
(P. mixta).		
(P. reptans).		
(P. Anserina).		
(Alchemilla arvensis).		
(Agrimonia Eupatoria).		
Rosa tomentosa	o	
R. uncinata	r	
R. canina (agg.)	o	r
R. lutetiana. } R. dumalis. }		
R. dumetorum	o	
R. urbica.		
R. arvensis	a	
Pyrus Malus, *var.* mitis	o	
P. torminalis	r	
Cretægus oxyacantha	o	
C. monogyna	o	
Haloragaceæ.		
Callitriche stagnalis	r	

	Calc. clay.	Loam.
Lythraceæ.		
Lythrum Salicaria	o	
Onagraceæ.		
Epilobium angustifolium	vr	o
E. hirsutum	o	
E. parviflorum	l	
E. montanum	o	
E. tetragonum	lo	
Circæa lutetiana	la	o
Cucurbitaceæ.		
(Bryonia dioica).		
Umbelliferæ.		
Sanicula europæa	o	
Pimpinella major	o	
Conopodium majus	r	r
(Chærophyllum temulum).		
(Anthriscus sylvestris).		
Angelica sylvestris	a	o
Heracleum Spondylium	o	r
(Caucalis Anthriscus).		
Araliaceæ.		
Hedera Helix	r	
Cornaceæ.		
Cornus sanguinea	a	
Caprifoliaceæ.		
Sambucus nigra	r	
Viburnum Opulus	o	
V. Lantana	o	
Lonicera Periclymenum	o	a
Rubiaceæ.		
Galium Mollugo	vr	
G. palustre	r	
(G. Aparine).		
Valerianaceæ.		
Valeriana officinalis	la	
Dipsacaceæ.		
Dipsacus sylvestris	o	
Scabiosa Succisa	.	la
Compositæ.		
(Bellis perennis).		
(Gnaphalium uliginosum).		
(Anthemis cotula).		
(Matricaria inodora).		
(M. Chamomilla).		
(Senecio Jacobæa).		
(S. erucifolius).		
(S. vulgaris).		

	Calc. clay.	Loam.
Compositæ (con.).		
Arctium nemorosum	o	
A. minus	o	
Carduus crispus	l	
(Cnicus lanceolatus).		
Cn. palustris	a	
(Cn. arvensis).		
(Centaurea nigra).		
(Lapsana communis).		
Picris hieracioides	r	
(P. echioides).		
(Crepis capillaris).		
(C. biennis).		
Hypochœris radicata	r	
Leontodon hispidus	r	
(Taraxacum officinale).		
(Sonchus asper).		
Campanulaceæ.		
Campanula Trachelium	la	
Primulaceæ.		
Primula elatior	a	
× P. vulgaris	a	
P. vulgaris	a	a
var. caulescens	r	
P. veris	r	
× P. vulgaris	vr	
Lysimachia Nummularia	o	
(Anagallis arvensis).		
Oleaceæ.		
Fraxinus excelsior	a-ls	r
Ligustrum vulgare	o	
Gentianaceæ.		
Centaurium umbellatum	o	
Boraginaceæ.		
Myosotis arvensis, *var.* umbrosa	la	
Convolvulaceæ.		
(Convolvulus arvensis).		
Scrophulariaceæ.		
Scrophularia nodosa	o	
Digitalis purpurea	vr	
(Veronica Tournefortii).		
(V. arvensis).		
(V. serpyllifolia).		
V. Chamædrys	o	o
Bartsia Odontites	o	
Euphrasia nemorosa	r	
Labiatæ.		
(Mentha arvensis).		

	Calc. clay.	Loam.
Labiatæ (con.).		
Nepeta hederacea	a	o
Prunella vulgaris	o	o
Stachys officinalis	o	
S. sylvatica	r	
(Galeopsis Ladanum).		
Lamium Galeobdolon	r	
Ajuga reptans	a	o
(*Plantaginaceæ*).		
(Plantago lanceolata).		
(P. media).		
(P. major).		
Polygonaceæ.		
Rumex viridis	a	r
(R. obtusifolius).		
(R. crispus).		
Euphorbiaceæ.		
Mercurialis perennis	ls	
Urticaceæ.		
Ulmus hollandica	vr	
U. glabra	o	o
U. sativa	o	
Urtica dioica	r	
Cupuliferæ.		
Betula alba	..	r
B. tomentosa	vr	o
Carpinus Betulus	vr	
Corylus Avellana	d	a
Quercus Robur	d	d
Salicaceæ.		
Salix cinerea	o	
S. capræa	r	
Populus tremula, *var.* villosa	a	o
Orchidaceæ.		
Listera ovata	o	
Orchis mascula	a	
O. maculata	r	
Habenaria virescens	o	
Dioscoreaceæ.		
Tamus communis	r	
Liliaceæ.		
Scilla nonscripta	la	
Paris quadrifolia	o	
Juncaceæ.		
(Juncus bufonius).		
J. effusus	o	
J. inflexus	o	
J. articulatus	o	
Luzula pilosa	o	a
L. sp.	..	r

	Calc. clay.	Loam.
Juncaceæ (con.).		
Luzula campestris	..	r
L. multiflora f. congesta	..	la
Typhaceæ.		
Sparganium erectum	vr	
Araceæ.		
Arum maculatum	o	
Lemnaceæ.		
Lemna minor	r	
Alismaceæ.		
Alisma Plantago-aquatica	vr	
Cyperaceæ.		
Carex vulpina	o	
var. nemorosa	r	
C. muricata	r	
C. divulsa	r	
C. remota	la	
C. flacca	o	
C. leporina	..	r
C. pilulifera	..	o
C. pallescens	o	
C. sylvatica	a	
C. acutiformis	r	
C. riparia	o	
Gramineæ.		
Phalaris arundinacea	r	
Anthoxanthum odoratum	o	la
Milium effusum	lo	
(Phleum pratense).		
(Agrostis alba, *var.* stolonifera).		
A. tenuis	o	o
Calamagrostis Epigeios	lo	o
C. lanceolata	o	la
Deschampsia cæspitosa	ls	o
Holcus mollis	..	s
(Avena fatua).		
(Arrenatherum elatius).		
Phragmites communis	vr	
Cynosurus cristatus	r	
Dactylis glomerata	o	
(Briza media).		
(Poa annua).		
P. nemoralis	o	r
(P. pratensis).		
P. trivialis	o	
Glyceria aquatica	vr	
(Festuca arundinacea).		
Bromus giganteus (= Festuca).	o	
Bromus ramosus	la	
Brachypodium sylvaticum	la	
(Lolium italicum).		
Filices.		
Pteris aquilina	..	ls

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EXPLANATION OF THE PLATES.

PLATE 12.

Central part of Gamlingay Wood, showing distribution of trees and shrubs of (Ash) Oak-Hazel Wood on calcareous clay and of Dry Oak Wood on an island of non-calcareous clay.

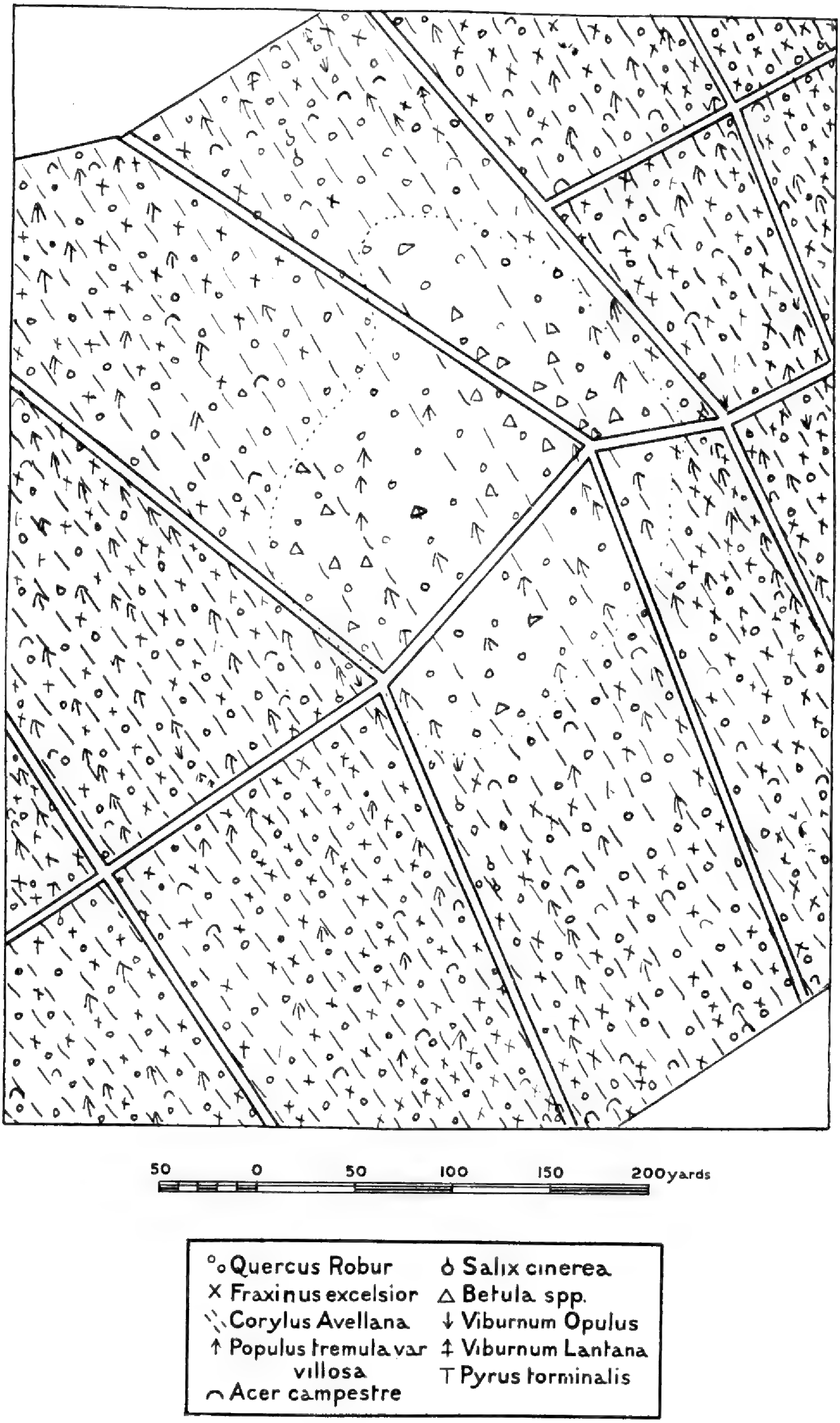
PLATE 13.

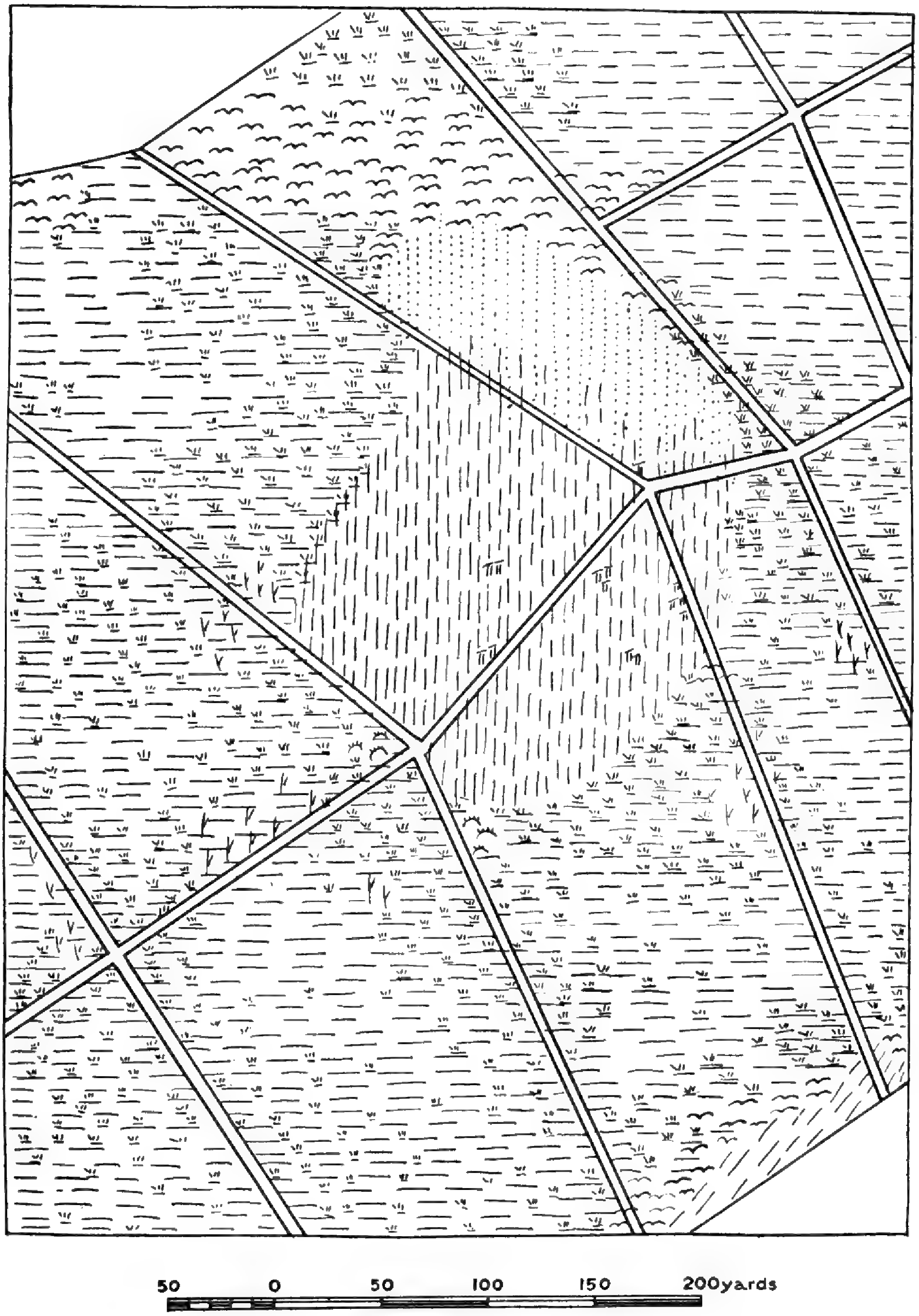
The same, showing distribution of societies of the ground flora.

PLATE 14.

Fig. 1. *Spiræa Ulmaria* Society. Vernal aspect, with *Primula elatior* and first leaves of *Spiræa*.

2. *Spiræa Ulmaria* Society. A wet part with *Carex riparia* very abundant.


50 0 50 100 150 200 yards
°o Quercus Robur
× Fraxinus excelsior
Corylus Avellana
↑ Populus tremula var villosa
⌒ Acer campestre
ổ Salix cinerea
△ Betula spp.
↓ Viburnum Opulus
‡ Viburnum Lantana
T Pyrus torminalis



Spiraea Ulmaria Soc. | Mercurialis Soc.
Ditto with Carex spp. | Fragaria ״
Spiraea Deschampsia Soc. | Pteris aquilina ״
Ditto with Juncus spp. | Holcus mollis ״
Polytrichum

FIG. 1.

FIG. 2.

FIG. 3.

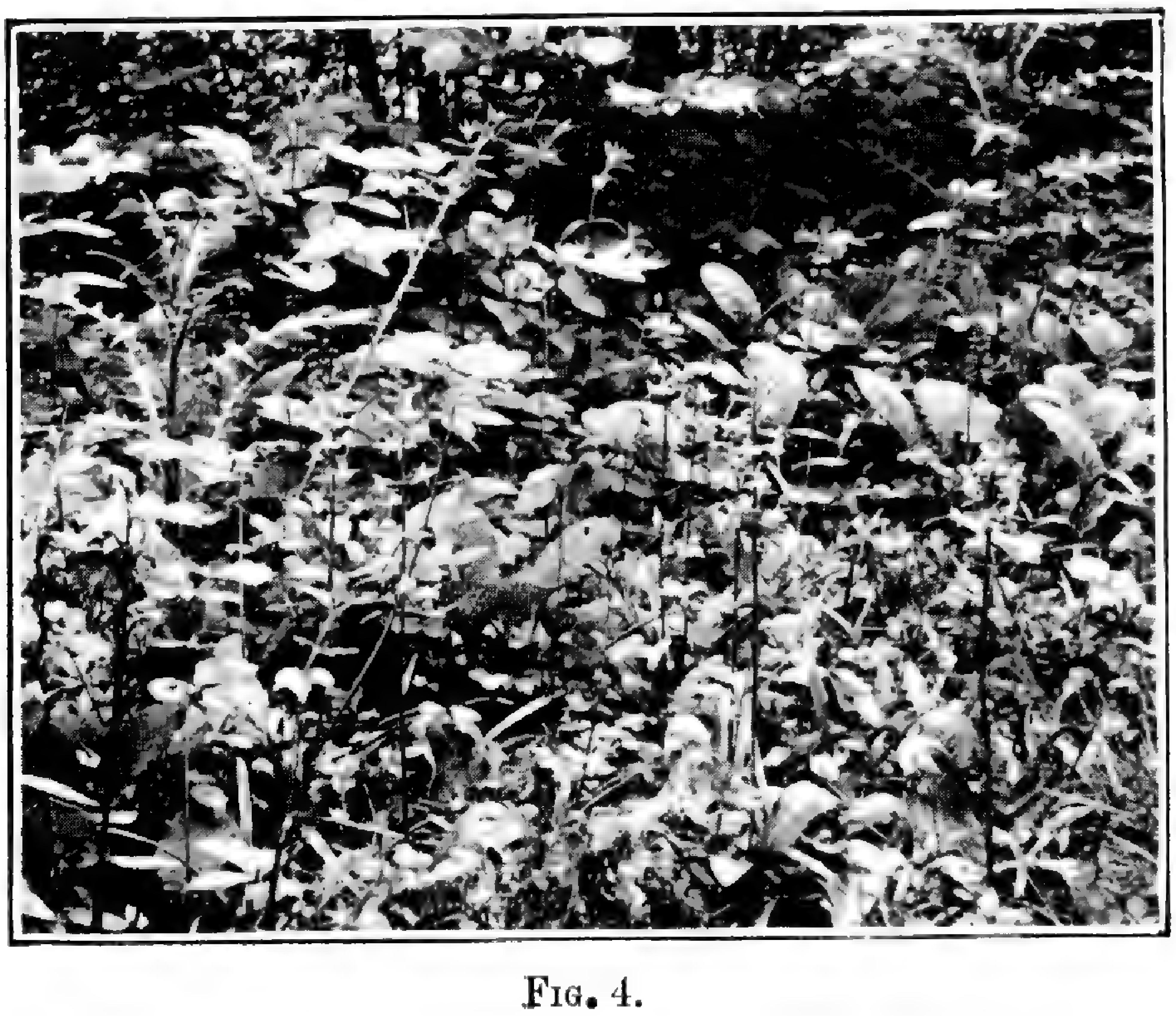


FIG. 4.

FIG. 5.

FIG. 6.

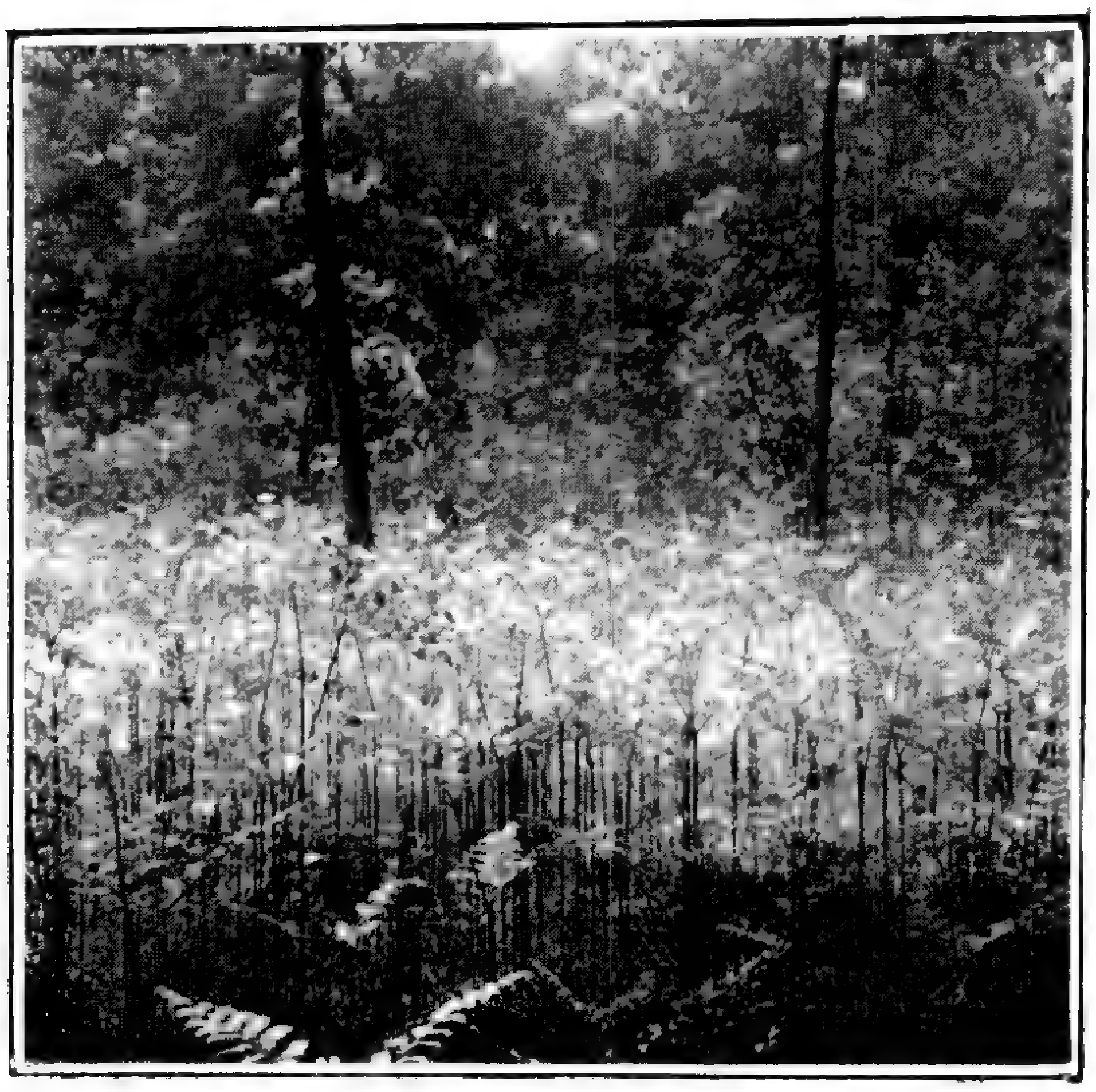


FIG. 7.

FIG. 8.

PLATE 15.

Fig. 3. *Spiræa Ulmaria-Deschampsia cæspitosa* Society. A wet part with *Juncus effusus* abundant and *Cnicus palustris*.

4. *Fragaria vesca* Society. Showing mixed nature: *Habenaria virescens, Primula elatior, Spiræa Ulmaria, Cnicus palustris, Scilla nonscripta*, and *Rubus* sp.

PLATE 16.

Fig. 5. *Mercurialis perennis* Society. *Mercurialis* dominant with *Scilla*, and *Rubus cæsius*.

6. *Pteris aquilina-Holcus mollis* Society. Vernal aspect.

PLATE 17.

Fig. 7. *Pteris aquilina-Holcus mollis* Society. Early summer aspect showing absence of shrubs.

8. The same. Late summer aspect showing *Betula*.

SUPPLEMENT.

SINCE the above was printed the following analyses of soils from Gamlingay Wood, carried out at the laboratories of the Rothamsted Experimental Station, have come to hand.

SOIL A.

Soil from *Spiræa Ulmaria* Society in deep shade:—

A_1. Top inch soil blackish brown.
A_2. 2–6 inches darkish coloured with *Spiræa* rhizomes.
A_3. 7–22 „ light yellow clay or loam. Roots to 14 ins.
A_4. 22– „ clay with numerous chalky lumps.

	A_1.	A_2.	A_3.	A.
Stones over 3 mm.	Nil	0·45	0·60	8·1
Fine gravel above 1 mm.	0·33	0·69	0·71	2·26
Coarse sand 1–0·2 mm.	25·76	22·53	14·91	10·08
Fine sand 0·2–0·04 mm.	3·92	14·91	12·26	8·26
Silt 0·04–0·01 mm.	14·68	18·69	10·30	7·59
Fine silt 0·01–0·005 mm.	8·59	8·42	6·62	15·96
„ „ 0·005–0·002 mm.	8·07	5·79	4·57	24·91
Clay below 0·002 mm.	9·21	13·71	35·51	0·02
Loss on sol. in N/5 HCl	4·57	4·50	7·42	10·50
Loss on ignition of dry sample	12·52	7·74	7·36	22·97
Moisture	3·38	3·26	5·33	1·59
Potash (K_2O)	not determined.	0·48	not determined.	0·756
Phosphoric acid (P_2O_5)		0·074		0·119
Lime ($CaCo_3$)	0·12	0·04	0·3	19·50
Humus	3·95	3·0	3·78	2·38
Reaction to Litmus	neutral.	very slightly acid.	alkaline.	distinctly alkaline.

SOIL B.

Soil from *Spiræa Ulmaria-Deschampsia cæspitosa* Society near border of Loam area :—

B_1. 1–5 inches. Soil uniform dark with humus.
B_2. 6–18 „ Soil a yellow loam with occasional small flints.
B_3. 18–24 „ Soil a grey Boulder-Clay with abundant chalky lumps.

	B_1.	B_2.	B_3.
Stones over 3 mm.	3·52	3·1	4·35
Fine gravel above 1 mm.	0·34	0·63	0·03
Coarse sand 1–0·2 mm.	32·10	22·68	7·69
Fine sand 0·2–0·04 mm.	13·84	14·23	7·53
Silt 0·04–0·01 mm.	17·56	17·29	5·47
Fine silt 0·01–0·005 mm.	6·06	6·65	4·88
„ „ 0·005–0·002 mm.	5·01	4·62	6·19
Clay below 0·002 mm.	11·28	26·38	18·79
Loss on sol. in N/5 HCl	3·93	4·94	42·87
Loss on ignition of dry sample	10·67	6·24	20·96
Moisture	2·70	3·15	2·87
Potash (K_2O)	0·388	0·777	0·699
Phosphoric acid (P_2O_5)	0·062	0·053	0·083
Lime ($CaCO_3$)	nil.	nil.	19·84
Humus	3·53	2·70	1·58
Reaction to Litmus	acid.	slightly acid.	alkaline.

SOIL C.

Soil from *Holcus mollis* Society of Dry Oak Wood.

Soil a sandy loam—darkish with much humus in first foot. Below this yellow-brown with angular flints. Shrub-roots abundant to 15 ins. Deeper soil bright yellow :—

C_1. First inch with surface humus. C_3. 7–15 inches.
C_2. 2–6 inches. C_4. 15–30 „

	C_1.	C.	C_3.	C_4.
Stones over 3 mm.	7·4	6·1	6·76	4·05
Fine gravel over 1 mm.	1·56	3·55	2·48	2·44
Coarse sand 1–0·2 mm.	36·61	41·43	37·05	23·64
Fine sand 0·2–0·04 mm.	13·63	14·78	16·96	17·76
Silt 0·04–0·01 mm.	14·63	14·77	12·21	4·95
Fine silt 0·01–0·005 mm.	7·05	6·25	8·79	5·13
„ „ 0·005–0·002 mm.	3·84	3·62	2·29	6·99
Clay below 0·002 mm.	13·10	4·91	10·16	23·77
Loss on sol. in N/5 HCl	4·20	3·13	2·94	5·02
Loss on ignition of dry sample	4·26	8·43	5·43	5·03
Moisture	2·94	2·19	2·13	4·19
Potash (K_2O)	0·486	0·213	} not	0·699
Phosphoric acid (P_2O_5)	0·092	0·059	} determined.	0·130
Lime ($CaCO_3$)	nil.	nil.	nil.	nil.
Humus	4·60	3·75	2·30	1·37
Reaction to Litmus	acid.	acid.	acid.	acid.

Soils D and E.

Soil D from around the roots of *Digitalis purpurea*.

Soil E ,, ,, *Epilobium angustifolium*.

Both from the calcareous clay, where neither of these plants would at first be expected.

	D.	E.
Stones over 3 mm.	0·2	nil.
Fine gravel over 1 mm.	2·55	0·28
Coarse sand 1–0·2 mm.	37·06	15·29
Fine sand 0·2–0·04 mm.	18·33	11·86
Silt 0·04–0·01 mm.	15·21	11·91
Fine silt 0·01–0·005 mm.	7·74	6·91
,, ,, 0·005–0·002 mm.	3·53	6·46
Clay below 0·002 mm.	6·30	25·54
Loss on sol. in N/5 HCl	2·47	8·34
Loss on ignition of dry sample ..	8·04	14·06
Moisture	2·18	5·84
Potash (K_2O)	0·350	0·991
Phosphoric Acid (P_2O_5)	0·077	0·124
Lime $CaCO_3$	nil.	0·14

R. S. A.

14th December, 1911.

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BOTANY

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THE JOURNAL

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On the Occurrence of *Amphidinium operculatum*, Clap. & Lach., in vast Quantity, at Port Erin (Isle of Man). By Prof. W. A. Herdman, F.R.S., F.L.S.

(Plate 18.)

[Read 1st June, 1911.]

In going to and fro between the village of Port Erin and the Biological Station, during the recent Easter vacation, I had occasion to take a short cut across the sandy beach at least twice and sometimes six times in the day. One gets into the habit, in these traverses, of looking closely at the beach when the tide is out, on the chance of seeing something of interest cast up. On April 7th, I noticed a new and quite unusual appearance on the sand at or a little above half-tide mark. The hollows of the ripple-marks and other slight depressions formed by the water draining off the beach were occupied or outlined by a greenish-brown deposit which in places extended on to the level so as to discolour patches of the sand (see Pl. 18. fig. 1).

Here the deposit remained, more or less, for a month—waxing and waning, sometimes increasing in a tide, say, roughly tenfold, and at other times apparently disappearing for a day or two and then re-appearing either on the same part of the beach, or it might be a few hundred yards away. At one time it discoloured a continuous stretch of sand about 50 yards long by 5 yards in breadth just below high-water mark, and was noticeable from some distance away.

At the first glance I supposed the appearance was caused by a deposit of Diatoms, but on taking a sample to the laboratory, microscopic examination showed that although a few diatoms (including *Navicula Amphisbæna* *, or a closely allied form) were present, the deposit was formed almost wholly of enormous numbers of a very active little Peridinian or Dinoflagellate of a bright yellow colour. More careful investigation enabled me to identify this form as *Amphidinium operculatum*, described by Claparède and Lachmann, in 1858, from specimens obtained at Christiansand, Bergen, and a few other places in Norway.

The published records of *Amphidinium*, however, do not give the impression that it is a common or abundant organism. The latest comprehensive work on such forms—the article on Peridiniales, by Paulsen, in the 'Nordisches Plankton' (Kiel, 1908)—recognises 4 species of *Amphidinium* : *A. crassum*, *A. rotundatum*, and *A. longum*, which as yet have been recorded from Kiel

* See postscript at end of this paper.

only; and *A. operculatum*, which is stated to occur in brackish water on the north coasts of Europe. In addition, Kofoid ('Dinoflagellata of the San Diego Region,' 1907) records *A. lacustre* from fresh water, *A. aculeatum*, a pelagic form from Naples, and *A. sulcatum*, which he took in a vertical haul from 90 fathoms in the Pacific.

On hunting through the few scattered references to *A. operculatum* which occur, one finds, however, that R. S. Bergh, in the 'Zoologischer Anzeiger' for 1882, states (p. 693) that Spengel in December and January found it in huge quantities on the beach at Norderney. Although, therefore, *Amphidinium operculatum* has been recorded once before as occurring in quantity, the occurrence appears to be a sufficiently rare event to be worthy of notice; and, so far as I can ascertain, the species, although known from several parts of North-west Europe, has not been previously found on the British coasts. I have written to most of the marine laboratories (Plymouth, Cullercoats, St. Andrews, and Millport) and to many marine biologists and have not been able to hear of any British record.

It is, however, not an unknown thing for rare Dinoflagellates to appear suddenly in some locality on an occasion in phenomenal quantities. Torrey, in the 'American Naturalist' for 1902, describes the unusual occurrence of a species of *Gonyaulax* on the coast of California. Sherwood and Vinal Edwards, in the 'Bulletin of the United States Bureau of Fisheries' for 1901, tell how for two weeks in September a *Peridinium* infested Narragansett Bay in such numbers as to colour the water blood-red and cause the death of many fishes.

Finally, Whitelegge, in the 'Records of the Australian Museum' for 1891, gives an interesting account of a new species of *Glenodinium* (*G. rubrum*) which appeared in such quantities in Port Jackson as to give the water "the appearance of blood" and cause the death of great numbers of oysters, mussels, and all forms of shore life. Whitelegge supposed that the very heavy rainfall that year, by affecting the salinity of the water, and then a lengthened period of calm weather which followed, may have provided favourable conditions for an unusual development of the Dinoflagellata. The *Glenodinium* appeared in vast numbers about the middle of March and disappeared early in May. When it was at its climax, the allied colourless species *Gymnodinium spirale* appeared in the bay and soon increased greatly in numbers and became finally even more abundant than the red *Glenodinium* upon which it was evidently feeding.

Returning now to our *Amphidinium operculatum*, it is not easy to account for the sudden appearance of this unusual Dinoflagellate (previously unrecorded in Britain) in such profusion on the beach at Port Erin last April. Plankton hauls were being taken regularly across the bay at the time, and they showed no trace of the organism. In fact, *Amphidinium* has not occurred in any of the thousands of gatherings which we have taken in the

Irish Sea during the last four years, and which have been examined in minute detail by Mr. Andrew Scott, A.L.S.

Thinking it might be present in the shallow water close to the edge of the beach, Mr. W. Riddell and I took some hauls of the tow-net from a punt worked backwards and forwards in a few inches of water as near as we could get to the discoloured sand, but the gathering, although it contained fine sand and mud, showed no trace of our Dinoflagellate. It may be noted here hat although the size of the *Amphidinium*, 0·05 mm. in greatest diameter, is such that it can slip through the mesh (averaging about 0·08 mm.) of the finest plankton silk (no. 20), still so much clogging of the meshes always takes place in such hauls, and so many other smaller organisms and particles of mud are retained, that it is certain that had the *Amphidinium* been present in any quantity in the water it would have shown up in the gatherings.

Careful scraping of the sand showed that the Dinoflagellates were only in and on the surface-layer, and therefore could not be regarded as coming up from below. It occurred to us that possibly they might be fresh- or brackish-water forms derived from the land; but we ascertained that the little stream in the centre of the bay, which in wet weather overflows on to the beach (at other times it is conveyed into the town sewer), had not, on account of the unusually dry season, sent any water to the beach for some weeks. Moreover, on experimenting with the living *Amphidinium* in the laboratory, we found that while it lived well in sea-water it died at once in fresh and survived for a few days only in brackish water. Samples of the *Amphidinium* kept in shallow dishes of wet sand at the Biological Station in a few days showed such profuse growth that the sand was covered by a dark-coloured layer, the water became impure, and eventually all the Dinoflagellates died off.

Observation under the microscope shows that although this is a singularly active Dinoflagellate, circling round and round with great vigour, so that a drop of sand and water containing a number of the organisms presents a most animated picture under a low power magnification, still the *Amphidinium* seems to be actually attracted to the sand-grains and associated with them. The sand-grains in the field of view are always peppered over with a number of specimens of the *Amphidinium* (Pl. **18.** figs. 2, 3, 4), and if individuals be watched they are seen after swimming round to come back to rest on a sand-grain and remain there for a time before starting off on another excursion. If they are thus constantly associated with sand-grains or other solid particles, and never swim more than a microscopic distance from such a resting-place, that may account for the fact that we have never found them in our plankton gatherings.

Amphidinium operculatum is also, however, positively heliotropic, congregating in quantity on the lighter side of the dish in the laboratory, and

shifting in bulk from the sand at the darker part of a tank to the end nearer the window. This property accounts for the invariable occurrence of the discoloured sand on the surface only and never in the deeper layers.

The published figures of this species are not very good, so a view of both dorsal and ventral surfaces, as seen under a high magnification, is given here (Pl. **18**. fig. 5). There certainly seems to be a slight but definite cuticle covering the greater part of the surface, although this has been denied by some previous writers. The two characteristic Dinoflagellate grooves certainly join, as is stated by Calkins but not by other observers.

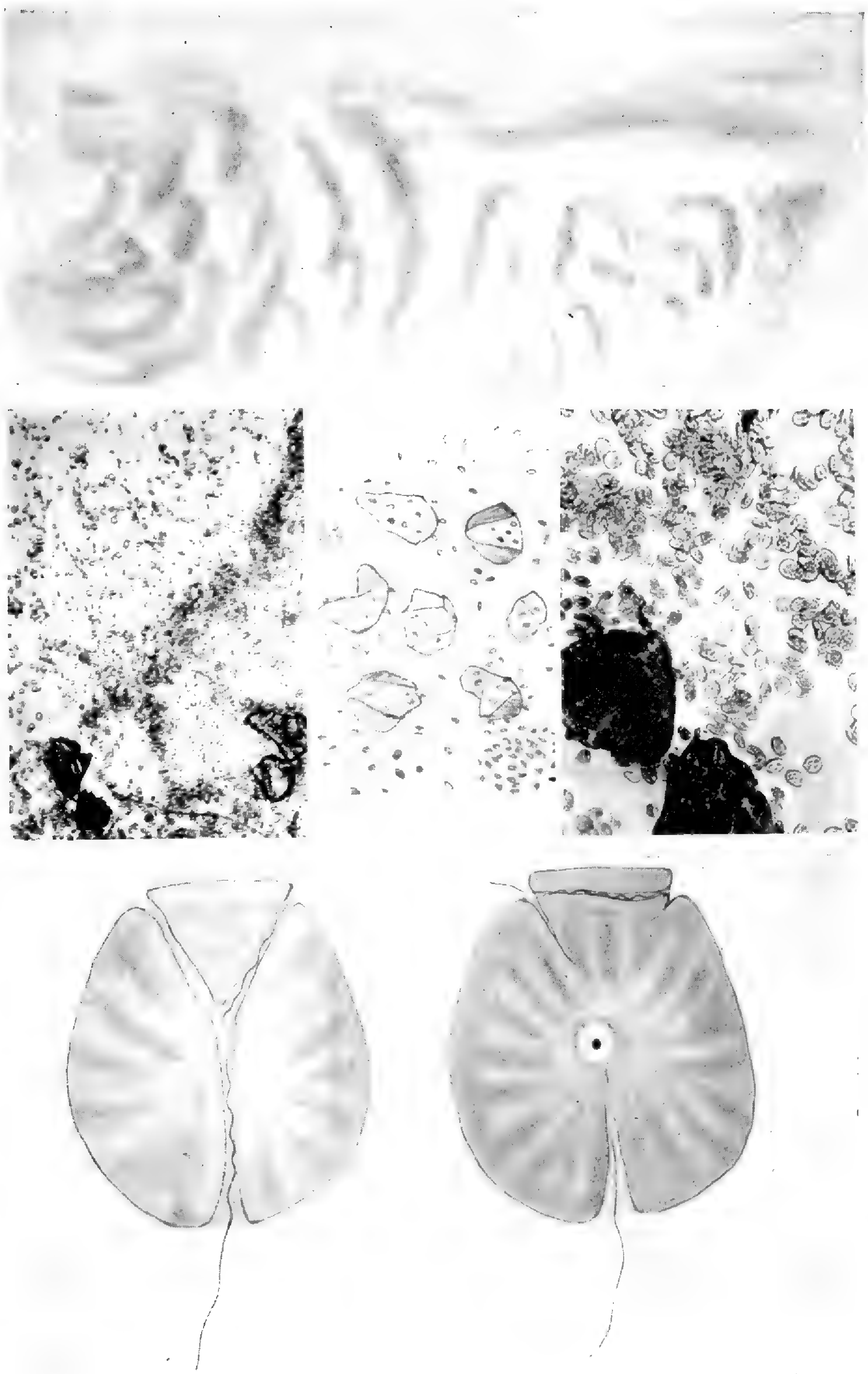
The posterior flagellum which projects freely from the body is not difficult to see, but the anterior one which lies along the transverse groove is not so easy to demonstrate, and may differ a little in position and extent from what is shown in the figure.

Stages in longitudinal fission were frequently seen, and that is probably the commonest method of reproduction. What appeared to be conjugation between two individuals was observed in one instance.

It may be that this organism lives normally in small quantities, so as not to be conspicuous, in some region of the sandy beach, or possibly in some special habitat beyond the beach, and that the present vast increase in numbers has been due to some unusual conjunction of circumstances; but what these were I am not prepared to suggest. In the case of the Port Jackson *Glenodinium* plague, Whitelegge thought the increase may have been due to exceptional rainfall and calm weather; but the occurrence this spring at Port Erin was preceded by unusually dry, but rather stormy, weather.

I am inclined to think that, although I can find no previous record of such an occurrence, it is probable that these swarms of *Amphidinium* have been seen before at Port Erin, and possibly elsewhere. I fancy I have seen the phenomenon myself in the past, and have supposed it to be due to swarms of Diatoms, which certainly do cause some of the yellowish-green and brownish-green patches on the sand between tide-marks.

Postscript, *June 5th*, 1911.—Two days after reading the above paper before the Linnean Society I was again on the beach at Port Erin. I found in the same region what was apparently the same patch of discoloured sand, but on examining a scraping with the microscope found that the deposit was now wholly composed of a golden-yellow Naviculoid Diatom—one of the "*Amphisbæna* group" of *Navicula*. I have searched the beach carefully between tide-marks, and have examined samples from every suspected patch of sand, but can find no trace of *Amphidinium*. The *Navicula*, which was present in April in very small quantity (see above), seems to have completely replaced the Dinoflagellate. We have probably still much to learn in regard



AMPHIDINIUM OPERCULATUM.

to the comings and goings of such microscopic forms and their physiological inter-relations in connection with what may be called "the metabolism of the beach."—W. A. H.

Sept. 9th.—The *Amphidinium* is now back again in abundance, and the Diatoms are absent.—W. A. H.

EXPLANATION OF PLATE 18.

Fig. 1. The general appearance of the brown deposits in the ripple-marks on the sand, reduced in size.

2. Sand-grains and *Amphidinium* (photo-micrograph under low-power magnification).
3. Sketch from living preparation, to show some *Amphidinia* resting on the sand-grains and others swimming about (low power).
4. Part of fig. 2 under high-power magnification.
5. Dorsal and ventral views of *Amphidinium operculatum*—enlarged from high-power magnification.

For the photo-micrographs reproduced as figures 2 and 4, I am indebted to my friend Mr. Edwin Thompson.

[Reprinted from the Journal of the Linnean Society (Zoology), Vol. xxxii. (1911) pp. 71–5, Pl. 8; the original pagination is given at the bottom of each page.]

On the Periodicity of the Phytoplankton of some British Lakes.

By W. West, F.L.S., and G. S. West, M.A., D.Sc., F.L.S.

(Plate **19** and 4 Text-figures.)

[Read 21st March, 1912.]

Introductory Remarks.

Up to the present little or nothing has been known of the periodicity of the British freshwater phytoplankton, a fact which, although rather deplorable in view of the extensive periodical plankton-investigations carried out in other countries during the past eight or ten years, may be attributed very largely to the comparative inaccessibility of the British lakes. For the most part, the lakes of the British Islands are situated at considerable distances from the great centres of population, and for the busy individual, with multifarious duties to perform, it is by no means easy to visit even a few selected lakes at frequent intervals throughout the year. Moreover, the expense incurred is very considerable.

By the aid of a grant from the Government Grant Committee of the Royal Society, and after much trouble, we succeeded in making the necessary arrangements for the regular monthly collection of plankton from several selected lakes. These were Ennerdale Water, Wastwater, and Windermere, in the English Lake District ; and Loch Lomond, Loch Katrine, Loch Lubnaig, and Loch Earn, in Scotland. Owing to unforeseen difficulties, however, the collections from Loch Earn could only be made for four months, and are therefore of small value, and those from Loch Lubnaig are likewise incomplete.

In all cases the collections were made from boats by means of the fine silken tow-nets we have previously described.

The first British record of the periodicity of phytoplankton is the account given by Fritsch * of the Thames river-plankton, in which he records the results of eight collections made from October 1902 to July 1903. Periodic collections of plankton were made in Loch Ness, Inverness, in 1904–05, and the results were published by Bachmann † in 1907. We have ourselves made brief reference to the periodicity of British river- and lake-plankton ‡, and have also published a complete account of the periodicity of the phytoplankton of Windermere §. These published results are discussed in their proper place, along with further investigations, and with the work done by investigators in other countries.

* F. E. Fritsch, in Ann. Bot. vol. xvii. (Sept. 1903).

† H. Bachmann, in Archiv für Hydrobiol. u. Planktonkunde, vol. iii. (1907).

‡ W. & G. S. West, in Proc. Roy. Soc. B, vol. lxxxi. (1909).

§ W. & G. S. West, in 'The Naturalist,' May–July 1909.

Most of our plankton-investigations have been of a qualitative character, as it was thought desirable that the pioneer work should be the acquirement of a sound general knowlege of the British freshwater phytoplankton, an exact knowledge of its constituents, and the points wherein the British phytoplankton differs so conspicuously from that of Central Europe and elsewhere. By a prolonged plankton-investigation of all the British lake-areas during the past ten years, we have acquired this knowledge very thoroughly. It is only since 1907 that we have been conducting observations of a more quantitative character in several of the more important and accessible lakes with a view to obtaining a knowledge of the periodicity of the plankton-organisms. The more detailed quantitative work concerning the phytoplankton, which, so far as we can see, in the British lake-areas will be quite of subordinate value, can be done piecemeal at any time by sufficiently qualified persons who possess the necessary means and time.

1. Ennerdale Water, Cumberland.

The most western of all the English Lakes, Ennerdale Water lies in a drainage-basin of its own, between mountains which rise on each side to 2000 feet. Its situation is somewhat desolate, and the valley above the lake is strewn with numerous moraines. The contamination of the water must be very slight, as only three houses are situated near its shores. It is two and a half miles in length by three-quarters of a mile broad, and has an average depth of 62 feet, the maximum depth being 148 feet. The collections were made regularly from August 1908 to July 1909, and the following monthly statement gives a brief outline of the changes in the plankton.

Aug. 1st, 1908. Temp. of water 60° F. (=15·5° C.). Mostly a Desmid-plankton, principally of small species, of which the most abundant were a biradiate form of *Staurastrum jaculiferum*, *Arthrodesmus crassus*, *Cosmarium subarctoum*, and *C. abbreviatum* var. *planctonicum*. Many other small species were more or less common, and abnormalities of most of the species, due to rapid divisions, were frequent. Two other Chlorophyceous algæ were of interest and were both fairly common. One was a rather small free-floating species of *Tetraspora* in which the pseudo-cilia were very distinct. This we have named *Tetraspora limnetica*. The other was a curious species of *Ankistrodesmus* which, although very minute, reminded one most forcibly of the partially untwisted threads in a yarn. This we have named *A. tortilis*. Of the Diatoms, *Rhizosolenia morsa* was the only abundant species. Other common constituents were *Chroococcus minutus* and *Peridinium inconspicuum*. *Ceratium Hirundinella* was not so frequent as one would have expected. Rotifers were fairly common, especially *Notholca longispina*.

Sept. 4th, 1908. Temp. of water 59° F. (=15° C.). This collection was a Desmid-plankton with an abundance of *Ceratium Hirundinella*. As in the previous month, the smaller species of Desmids, and especially the spiny ones,

were abundant. *Spondylosium planum* was also very common, occurring in short filaments of from 3 to 22 cells. *Rhizosolenia morsa* was still common, and *Lyngbya limnetica* and *Chroococcus minimus* had greatly increased in amount. Rotifers fairly common, and a few Copepods.

Oct. 13*th*, 1908. Temp. of water 50° F. (=10° C.). Not much different from preceding month. A Desmid-plankton of small species, with a considerable quantity of *Ceratium Hirundinella*. *Rhizosolenia morsa* and *Lyngbya limnetica* both common. Rotifers fairly common.

Nov. 2*nd*, 1908. Temp. of water 47° F. (=8·3° C.). Small Desmids still common, but *Ceratium Hirundinella* greatly diminished in numbers. *Rhizosolenia morsa* at its maximum abundance, and *Lyngbya limnetica* still fairly common. Few Rotifers.

Dec. 11*th*, 1908. Temp. of water 46° F. (=7·7° C.). The small Desmids less numerous, the reduction in the numbers of *Arthrodesmus crassus* being especially noticeable. *Rhizosolenia morsa* still very common, but *Lyngbya limnetica* much reduced in amount. No Peridinieæ were observed. Rotifers fairly numerous.

Jan. 8*th*, 1909. Temp. of water 38° F. (=3·3° C.). Great reduction in the numbers of Desmids, although *Spondylosium planum*, *Arthrodesmus crassus*, *A. triangularis* var. *subtriangularis*, and *Staurastrum jaculiferum* (f. *biradiata*) are still evident. Much detritus present. *Rhizosolenia morsa* reduced in numbers, but *Lyngbya limnetica* much as in December. First appearance of *Peridinium Willei*. Rotifers rather rare.

Feb. 6*th*, 1909. Temp. of water 42° F. (=5·5° C.). The collection contained comparatively little phytoplankton. Some of the small spiny Desmids were not uncommon, and *Spondylosium planum* was not infrequent. Diatoms were few in numbers and Rotifers rare. The great bulk of the plankton consisted of Copepods.

March 3*rd*, 1909. Temp. of water 39° F. (=4° C.). There was a notable increase in the phytoplankton. The spiny Desmids again common, and *Arthrodesmus crassus* has reappeared. *Spondylosium planum* once more common. *Dictyosphærium pulchellum* and the young stages of *Sphærocystis Schroeteri* both very frequent. A noteworthy feature was the reappearance in quantity of *Rhizosolenia morsa* with rather shorter spines. Rotifers few, but Nauplii very numerous.

April 3*rd*, 1909. Temp. of water 42° F. (=5·5° C.). A poor plankton collection. The phytoplankton consisted mostly of a very even mixture of a few species, amongst which the spiny Desmids were the most conspicuous. Very few Rotifers or Copepods.

May 3*rd*, 1909. Temp. of water 50° F. (=10° C.). Smaller species of Desmids very numerous again, and owing to the relatively rapid divisions many abnormalities were noticed among the spiny species. *Sphærocystis Schroeteri* was common. Copepods and Nauplii both abundant.

TABLE OF PHYTOPLANKTON FROM ENNERDALE WATER.

In this Table the relative frequency of a species is indicated thus :—very rare, "rrr"; rare, "rr"; infrequent, "r"; fairly common, "c"; common, "cc"; abundant, "ccc."

SPECIES.	1908.					1909.						
	August. 15·5° C. (=60° F.).	September. 15° C. (=59° F.).	October. 10° C. (=50° F.).	November. 8·3° C. (=47° F.).	December. 7·7° C. (=46° F.).	January. 3·3° C. (=38° F.).	February. 5·5° C. (=42° F.).	March. 4° C. (=39° F.).	April. 5·5° C. (=42° F.).	May. 10° C. (=50° F.).	June. 13·3° C. (56° F.).	July. 17° C. (=62° F.).
Chlorophyceæ.												
Œdogonium sp. (sterile)	...	...	rrr	...	...	...	...	rrr	rrr	rrr		
Ulothrix zonata, (Web. & Mohr) Kütz.	...	...	...	...	...	...	...	...	...	r		
Myxonema subsecundum, (Kütz.) Hazen	...	...	...	...	...	...	...	...	rr			
Gonatozygon monotænium, De Bary	...	...	...	...	rr	...	...	...	...	rr	rr	
,, *Brébissonii*, De Bary	...	rrr	...	...	...	...	...	...	rrr			
,, *Kinahani*, (Arch.) Rabenh.	...	...	...	...	...	...	...	...	...	...	...	rrr
Genicularia elegans, W. & G. S. West	rrr	rrr	rrr	...	rrr	r	rr	...	...	...	...	rrr
Cylindrocystis diplospora, Lund., var. *major*, West	...	...	...	...	...	...	...	...	...	rr	rr	
Euastrum verrucosum, Ehrenb., var. *reductum*, Nordst.	...	...	...	...	...	...	...	...	...	rr	r	
Micrasterias Sol, (Ehrenb.) Kütz.	rrr											
Cosmarium abbreviatum, Racib., var. *planctonicum*, W. & G. S. West	ccc	cc	c	c	rr	rrr	...	rr	rrr	rrr	rr	c
,, *bioculatum*, Bréb.	rr	rr	...	...	...	...	...	r	...	r	r	
,, *connatum*, Bréb.	...	...	...	...	...	...	...	...	...	rrr	rr	
,, *contractum*, Kirchn., var. *ellipsoideum*, (Elfv.) W. & G. S. West	...	...	...	...	...	...	rrr					
,, *depressum*, (Näg.) Lund.	...	rrr	...	...	...	...	...	...	...	rrr		
,, *subarctoum*, (Lagerh.) Racib.	ccc	c	r	r	rrr	...	...	...	rr	r	c	cc
,, *subcrenatum*, Hantzsch	...	...	...	rrr	rrr							
Xanthidium antilopæum, (Bréb.) Kütz.	rr	r	...	...	...	...	...	rrr	...	rrr	rrr	rr
,, ,, var. *depauperatum*, W. & G. S. West	...	rr	rr	...	rrr	rr	rrr	rrr	rrr	r	r	r
Arthrodesmus crassus, W. & G. S. West	ccc	ccc	cc	c	rrr	rrr	...	rr	rr	c	c	cc
,, *Incus*, (Bréb.) Hass.	...	...	...	...	...	...	...	...	...	rrr		
,, *triangularis*, Lagerh., var. *subtriangularis*, (Borge) W. & G. S. West	cc	c	r	rr	rr	r	r	r	r	r	c	cc
Staurastrum anatinum, Cooke & Wills	rrr	...	rrr									

Staurastrum Arctiscon, (Ehrenb.) Lund.	rrr	...	...	...	...	...	...	...	...	...	rrr	rrr
,, *aculeatum*, (Ehrenb.) Menegh.	...	..	...	..	...	..	...	...	...	rrr		
,, *curvatum*, West	rr	...	rrr	...	rrr	...	...	rr	...	rr		
,, *cuspidatum*, Bréb., var. *maximum*, West	...	rrr	rr									
,, *dejectum*, Bréb.	rrr	rrr	...	...	...	rrr	...	...	...	rrr	rr	
,, *denticulatum*, (Näg.) Arch.	rr	r	rr	rr	rr	...	...	rr	...	...	r	
,, *furcigerum*, Bréb.	...	...	...	rrr								
,, *jaculiferum*, West, forma *biradiata*	ccc	cc	cc	c	c	r	r	c	c	c	cc	cc
,, *longispinum*, (Bail.) Arch.	...	...	...	...	...	rrr	...	...	...	rrr		
,, *lunatum*, Ralfs, var. *planctonicum*, W. & G. S. West	c	rr	...	rr	...	rrr	...	...	rr	r	c	rr
,, *megacanthum*, Lund., var. *scoticum*, W. & G. S. West	rrr	rrr	...	rrr								
,, *paradoxum*, Meyen, var. *longipes*, Nordst.	...	...	...	rrr	...	...	...	...	rrr			
,, *sexangulare*, (Buln.) Rabenh.	...	...	...	...	rrr							
,, *vestitum*, Ralfs	rrr	rrr	rrr									
Sphærozosma vertebratum, Ralfs, var. *punctulatum*, W. & G. S. West	. .	...	rrr									
Spondylosium planum, W. & G. S. West	rr	cc	c	c	c	r	r	c	...	...	...	rrr
Hyalotheca dissiliens, (Sm.) Bréb.	rrr	rrr	...	...	...	...	...	...	...	rr	rrr	
,, *mucosa*, (Dillw.) Ehrenb.	...	...	...	...	rrr	...	...	...	...	rr		
Oocystis parva, W. & G. S. West	r	rr	rrr									
,, *lacustris*, Chodat	...	...	...	rrr	rrr							
Ankistrodesmus falcatus, (Corda) Ralfs	rrr	...	...	rrr	rrr	rrr	...	rrr	...	...	...	rrr
,, ,, var. *spirilliformis*, G. S. West	...	...	rrr									
,, *tortilis*, sp. n.	r	...	...	...	...	...	...	...	...	rr	rr	rr
Dictyosphærium pulchellum, Wood	c	c	r	r	rrr	...	rrr	c	r	r	...	r
Botryococcus Braunii, Kütz.	...	...	...	...	...	...	...	...	...	rrr	rrr	rrr
Sphærocystis Schroeteri, Chodat	...	rrr	rrr	rr	r	rr	...	r	r	cc	ccc	r
Tetraspora limnetica, W. & G. S. West	c	...	...	...	...	...	...	...	...	...	...	rr
Glœocystis gigas, (Kütz.) Lagerh.	r	...	rrr	...	. .	...	rrr	rrr				
Heterokontæ.												
Askenasyella conferta, W. & G. S. West	cc	cc	c	c	rr							
Bacillarieæ.												
Cyclotella compta, Kütz.	rr	rrr	rrr	...	...	...	rr	rr	r	r	c	rr
Rhizosolenia morsa, W. & G. S. West	c	c	cc	cc	c	r	rr	r	r	...	...	r
Tabellaria fenestrata, (Lyngb.) Kütz.	rr	rr	rr	rrr	rrr	rrr	rrr	rr	rr	r	r	r
,, ,, var. *asterionelloides*, Grun.	...	...	..	...	...	...	...	...	...	...	rr	
,, *flocculosa*, (Roth) Kütz.	...	rrr	rr	...	rr	rr	...	rrr	rr	rr	rr	rr
Synedra Acus, (Kütz.) Grun.	...	...	rrr	...	rrr	rrr	.	..	...	...	...	rrr
,, *radians*, (Kütz.) Grun.	...	...	...	...	...	...	...	rrr	r	rr		
,, *Ulna*, (Nitzsch) Ehrenb.	...	...	...	rrr	rr	rrr	...	...	rrr	rrr	r	rrr
Asterionella formosa, Hass.	...	...	...	...	...	...	...	...	...	rrr		
Eunotia biceps, (W. Sm.) G. S. West	...	...	rrr									
,, *Diadema*, Ehrenb.	...	...	...	...	...	...	...	rrr				
,, *major*, (W. Sm.) Rabenh.	...	...	...	...	rrr	...	...	...	rrr	rrr	rr	
,, *pectinalis*, (Kütz.) Rabenh.	...	...	rr	...	...	...	...	. .	...	rr	r	

Phytoplankton from Ennerdale Water (*continued*).

Species.	1908. August. 15·5° C. (=60° F.).	September. 15° C. (=59° F.).	October. 10° C. (=50° F.).	November. 8·3° C. (=47° F.).	December. 7·7° C. (=46° F.).	1909. January. 3·3° C. (=38° F.).	February. 5·5° C. (=42° F.).	March. 4° C. (=39° F.).	April. 5·5° C. (=42° F.).	May. 10° C. (=50° F.).	June. 13·3° C. (=56° F.).	July. 17° C. (=62° F.).
Bacillarieæ (*cont.*).												
Achnanthes microcephala, Kütz.	rrr	rr	rrr	rrr	...	...	...	...	...	...	...	rr
Gomphonema intricatum, Kütz.	rr	rrr	rrr	rrr	rrr	rrr	rrr	rrr	rrr	...	...	rrr
Navicula alpina, (W. Sm.) Ralfs	...	...	...	...	rrr	...	...	...	...	...	rr	
,, *divergens*, Ralfs	...	...	rrr	...	rrr	...	...	...	rrr			
,, *major*, Kütz.	...	...	...	...	rrr	...	...	rrr				
Vanheurckia rhomboides, Bréb., var. *saxonica*, G. S. West	r	rr	rr	rrr	rrr	rrr	rrr	rrr	...	...	rrr	rrr
Cocconema cymbiforme, Ehrenb., var. *parvum*, (W. Sm.) V. Heurck	...	...	...	...	...	rrr	...	rrr	rrr			
Nitzschia Sigma, (Kütz.) W. Sm.	...	...	...	...	rrr	...	...	rrr	rrr	...	...	rrr
Surirella biseriata, Bréb.	...	...	...	...	rr	rr	...	rrr	...	rrr	rr	
,, *linearis*, W. Sm.	...	...	...	...	rrr	...	...	rrr	...	rrr	rrr	
,, *ovalis*, Bréb., var. *angusta*, (Kütz.) V. Heurck	...	...	...	rrr	...	...	...	rrr				
,, *robusta*, Ehrenb.	...	...	...	...	...	...	...	...	...	...	r	c
,, ,, var. *splendida*, (Ehrenb.) V. Heurck	...	rrr	...	...	rr	...	rrr	...	rr	rrr	r	c
Myxophyceæ.												
Plectonema Boryanum, Gomont	...	...	rrr	...	...	rrr	rrr	rrr	rrr			
Lyngbya limnetica, Lemm.	rr	r	c	r	r	rr	...	rrr				
Oscillatoria Agardhii, Gomont	...	...	...	...	...	rrr	...	...	...	...	...	rrr
Merismopedia glauca, (Ehrenb.) Näg.	...	rrr										
Aphanocapsa delicatissima, W. & G. S. West	rrr	...	...	rrr								
Aphanothece microscopica, Näg.	...	...	...	...	rrr							
Gomphosphæria lacustris, Chodat	...	...	...	...	...	rr	...	...	rrr	...	rrr	
Chroococcus minutus, (Kütz.) Näg.	cc	r	...	...	...	...	...	rrr				
,, *minimus*, (v. Keissler) Lemm.	r	c	rr	r								
Flagellata.												
Dinobryon cylindricum, Imhof	...	...	...	...	...	...	...	...	rrr	rr		
,, *crenulatum*, W. & G. S. West	rrr	...	...	...	...	...	...	...	...	rrr		
,, *elongatum*, Imhof	rr											
,, *sociale*, Ehrenb.	rr											
Synura uvella, Ehrenb.	rr	rrr										
Peridinieæ.												
Ceratium Hirundinella, O. F. Müller	rr	cc	cc	rr	...	...	...	...	...	r	c	c
Peridinium inconspicuum, Lemm.	c	r	r	rr	...	...	...	...	...	rrr	rr	r
,, *Willei*, Huitfeldt-Kaas	...	...	...	...	...	r	rrr	rr	rr	r	c	cc

June 1st, 1909. Temp. of water 56° F. (=13·3° C.). Considerable increase in the number of Desmids. *St. lunatum* var. *planctonicum* abundant, and many of the rarer species becoming frequent. *Sphærocystis Schroeteri* in great quantity, and *Peridinium Willei* quite common. No *Rhizosolenia* was observed either in this month or in May. Very few Rotifers, but many Copepods and Nauplii, and much detritus.

July 2nd, 1909. Temp. of water 62° F. (=17° C.). Largely a Desmid-plankton with Peridinieæ. Also much detritus. The small spiny Desmids and *Cosmarium subarctoum* very numerous. Rotifers fairly common. *Rhizosolenia morsa* reappeared in moderate quantity.

In Ennerdale Water the dominant constituents of the phytoplankton are Chlorophyceæ, more especially Desmids. Neither the Diatoms nor the Myxophyceæ are at any time conspicuous, although quantities of the delicate *Rhizosolenia morsa* occur at certain times. The total number of species observed from August 1908 to July 1909 was 91, of which 49 (or 53 per cent.) were Chlorophyceæ, 24 (or 26 per cent.) Bacillarieæ, 9 (or 9·9 per cent.) Myxophyceæ, 5 (or 5·5 per cent.) Flagellata, and 3 (or 3·3 per cent.) Peridinieæ.

If the foregoing table be compared with the list of phytoplankton found in this lake in May 1903 *, it will be seen that some 16 species which occurred at that time were entirely absent in the period from August 1908 to July 1909. All these constituents were, however, of the more casual type.

The plankton of Ennerdale Water has two very indistinct phases :—

I. *December–May* (cold period, with vernal rise of temperature). Mixed plankton ; Diatoms more or less frequent but none dominant ; Desmids in comparatively small numbers.

II. *June–November* (warm period, with autumnal decline of temperature). Desmid-plankton, with a few of the Protococcales, few Diatoms, and *Lyngbya limnetica.*

The dominant Desmids attain their maximum abundance in August, and maintaining their numbers through the autumnal fall in temperature, begin to visibly thin out in December. Of the few Protococcales which occur, *Dictyosphærium pulchellum, Askenasyella conferta,* and *Tetraspora limnetica* also reach their greatest abundance in August and September, whereas *Sphærocystis Schroeteri* is most numerous in June.

There is apparently no maximum of Diatoms in this lake, and with one exception almost all the recorded species are scarce. Particularly noticeable is the great scarcity of *Asterionella* and the star-dispositions of *Tabellaria,*

* *Vide* W. & G. S. West, in 'The Naturalist,' April 1909.

and *Melosira* is completely absent. *Rhizosolenia morsa* is the only Diatom which was observed to become abundant, attaining its greatest maximum in October and November (temp. 10° and 8·3° C. respectively) near the close of the autumnal decline in temperature, with a second slight increase in March and April. A similar periodicity was exhibited by this species in Wastwater.

FIG. 1.

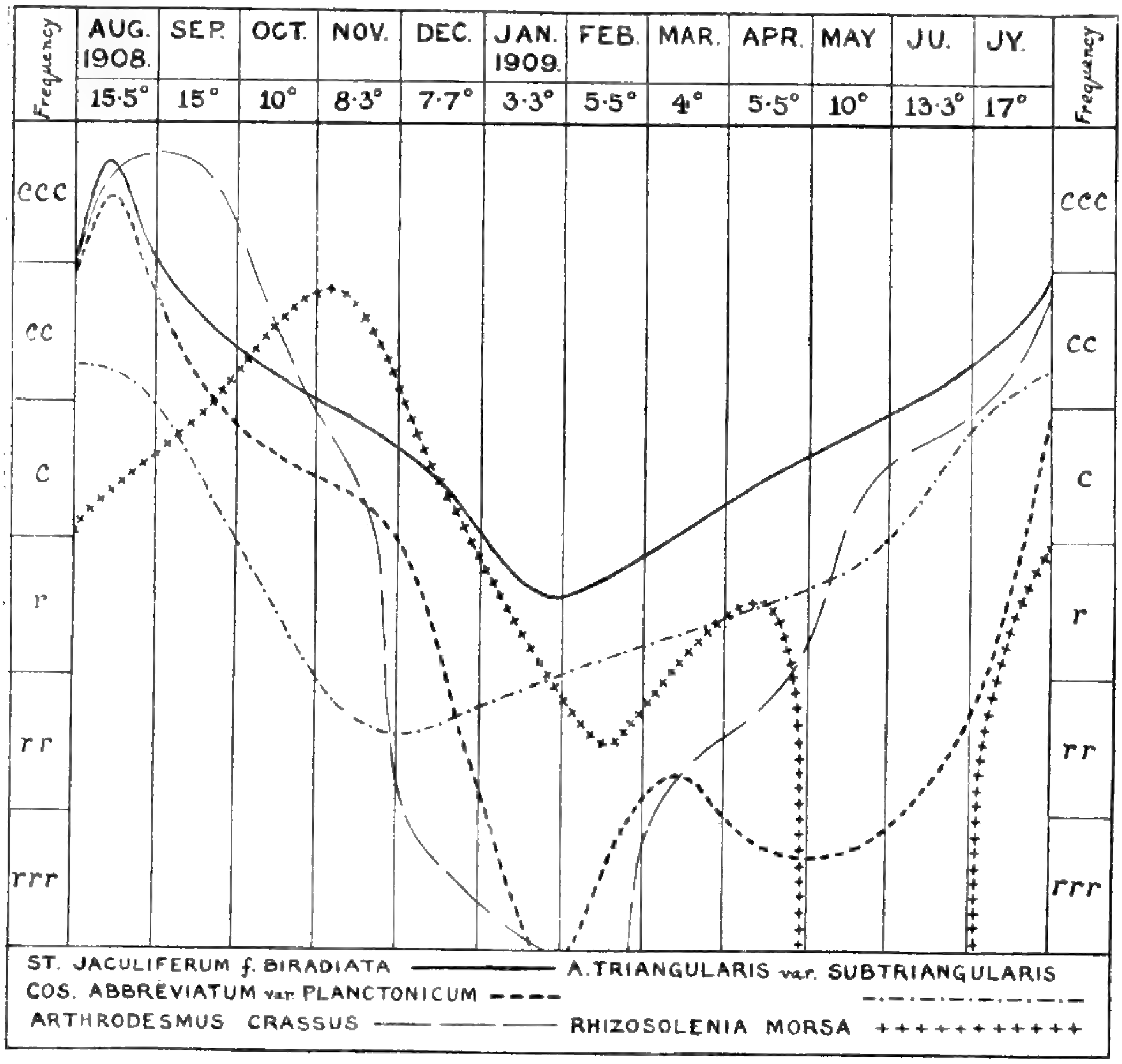


Chart of the periodicity of five of the most abundant constituents of the phytoplankton of Ennerdale Water. The temperatures are in degrees Centigrade.

Flagellates and Myxophyceæ are rare in Ennerdale Water, although there is a small maximum of *Lyngbya limnetica* in October.

Peridinium Willei only occurs from January to July, reaching its maximum in the latter month and then disappearing from the plankton. In

Windermere this organism attained its maximum in August, but persisted in very small numbers from September to December.

Ceratium Hirundinella had two maxima—a small one from June to July, and a more pronounced one from September to October.

2. Wastwater, Cumberland.

This is the deepest of the English lakes, having an average depth of 135 feet and a maximum depth of 258 feet. It is about three miles in length by about half a mile in breadth, and is 204 feet above sea-level. The drainage is received from the western side of Scafell (3162 feet) and Scafell Pike (3210 feet), and from the southern slopes of the Steeple, the Pillar, and Kirk Fell. The lake contains a large volume of water, and is practically free from all contamination. The collections were made at approximately monthly intervals from August 1908 to July 1909.

Aug. 4th, 1908. Temp. of water 63° F. (=17·2° C.). The dominant constituent of the phytoplankton was *Staurastrum jaculiferum*. A few other Desmids were present, but on the whole the amount of phytoplankton was rather small. *Peridinium Willei* was common. Rotifers were numerous and Copepods abundant.

Sept. 5th, 1908. Temp. of water 51° F. (=10·5° C.). Plankton not unlike that of previous month, with *Staurastrum jaculiferum* dominant. *Rhizosolenia morsa* and *Sphærocystis Schroeteri* both common. Rotifers numerous. Copepods abundant.

Oct. 5th, 1908. Temp. of water 60° F. (=15·5° C.). Phytoplankton not unlike that of September, with some abundance of *Staurastrum jaculiferum*. One of the most noteworthy Desmids was *Genicularia elegans*. *Sphærocystis Schroeteri* and *Rhizosolenia morsa* were both exceedingly abundant. Rotifers very abundant. Copepods few.

Nov. 4th, 1908. Temp. of water 54° F. (=12·2° C.). Phytoplankton very similar to that of October, with the same dominant species. *Genicularia elegans* also occurred again. Rotifers very abundant.

Dec. 3rd, 1908. Temp. of water 48° F. (=8·9° C.). Great reduction in quantity of *Sphærocystis Schroeteri* and slight diminution in *Staurastrum jaculiferum*, but considerable increase in *Rhizosolenia morsa*, which attains its maximum abundance in this month. Rotifers abundant. Few Entomostraca.

Jan. 4th, 1909. Temp. of water 46° F. (=7·8° C.). The numbers of *Staurastrum jaculiferum* further reduced, and also a considerable falling off in *Rhizosolenia morsa*. *Peridinium Willei* had become frequent. Large Copepods were the dominant feature of the plankton.

Feb. 5th, 1909. Temp. of water 42° F. (5·5° C.). *Staurastrum jaculiferum* still further reduced in numbers. Diatoms more numerous, especially

Table of Phytoplankton from Wastwater.

The relative frequency is indicated as before.

Species.	1908. August. 63° F. (=17·2° C.).	September. 51° F. (=10·5° C.).	October. 60° F. (=15·5° C.).	November. 54° F. (=12·2° C.).	December. 48° F. (=8·9° C.).	1909. January. 46° F. (=7·8° C.).	February. 42° F. (=5·5° C.).	March. 41° F. (=5° C.).	April. 40° F. (=4·4° C.).	May. 46° F. (=7·8° C.).	June. 54° F. (=12·2° C.).	July. 51° F. (=10·6° C.).
Chlorophyceæ.												
Œdogonium spp. (sterile)	rr	...	...	rrr	...	rrr	...	...	rr	...	rr	
Microspora amæna, (Kütz.) Rabenh.	...	...	...	...	...	...	...	...	...	...	rr	
Mougeotia spp. (sterile)	...	rrr	rrr	rrr	rrr	...	...	...	rrr	rrr	rr	
Genicularia elegans, W. & G. S. West	...	...	rr	rrr	...	...	...	...	...	rrr		
Pleurotænium Ehrenbergii, (Ralfs) De Bary	...	...	...	...	...	...	...	...	...	...	rrr	
Cosmarium Botrytis, (Bory) Menegh.	...	...	...	...	..	...	...	...	...	...	rrr	
,, *depressum*, (Näg.) Lund., var. *achondrum*, (Boldt) W. & G. S West	...	...	rr	..	rrr	...	...	...	...	...	rr	
,, *punctulatum*, Bréb	...	...	...	..	rrr							
Xanthidium antilopæum, (Bréb.) Kütz.	...	rrr										
Staurastrum curvatum, West	...	...	rrr	...	...	...	...	...	...	rrr	rrr	rrr
,, *cuspidatum*, Bréb., var. *maximum*, West	...	rrr	rr	rrr	rrr	rrr	...	...	...	rrr	rr	
,, *denticulatum*, (Näg.) Arch.	r	rr	...	...	rr	...	...	..	...	r	rr	r
,, *furcigerum*, Bréb.	rr	rrr	...	...	...	...	...	...	..	...	...	r
,, *jaculiferum*, West (f. *triradiata*)	ccc	ccc	ccc	ccc	cc	c	r	r	r	c	ccc	ccc
,, *lunatum*, Ralfs, var. *planctonicum*, W. & G. S. West	...	...	...	...	...	...	...	...	...	...	rr	
,, *paradoxum*, Meyen	rr	...	...	...	...	...	...	...	rrr			
Sphærozosma vertebratum, Ralfs, var. *punctulatum*, W. & G. S. West	...	rrr	...	...	...	...	...	...	...	...	rr	
Hyalotheca dissiliens, (Sm.) Bréb.	...	...	...	..	...	...	..	...	..	...	rr	
,, *mucosa*, Ehrenb.	...	...	rrr	...	...	rrr	...	...	...	...	...	rrr
Ankistrodesmus falcatus, (Corda) Ralfs, var. *acicularis*, (A. Br.) G. S. West	...	rr	...	...	...	...	...	...	...	rrr		
Elakatothrix gelatinosa, Wille	...	...	rrr	rrr	rrr	rrr	..	...	rrr	r	c	cc
Oocystis parva, W. & G. S. West	...	...	rrr	...	...	...	...	...	...	...	r	
,, *lacustris*, Chodat	...	rrr	r	rr	rrr	rrr	...	...	rrr	r	c	c
Glœocystis gigas, (Kütz.) Lagerh., var. *maxima*, West	...	...	...	...	...	...	...	rrr	rrr	rr	c	r
Sphærocystis Schroeteri, Chodat	c	cc	ccc	ccc	r	rr	...	...	rrr	r	c	c

Bacillarieæ.												
Melosira granulata, Ralfs	...	...	...	rrr	...	...	...	...	rrr			
Rhizosolenia morsa, W. & G. S. West	...	c	cc	cc	ccc	c	rr	rrr	...	r		
Tabellaria flocculosa, (Roth) Kütz.	...	rr	rr	...	rrr	...	...	rrr	...	...	r	rrr
,, *fenestrata*, (Lyngb.) Kütz.	rr	rr	rr	rr	...	rr	r	rr	...	rr		
Fragilaria capucina, Desmaz.	...	rrr	...	...	...	...	...	...	...	rr	rr	
Synedra Acus, (Kütz.) Grun.	...	...	...	...	...	...	rr	rr	...	...	rr	
,, *pulchella*, Kütz.	...	...	...	rrr	rrr							
Ceratoneis Arcus, (Ehrenb.) Kütz., var. *Amphioxys* (Rabenh.) De Toni	...	...	...	...	...	rrr	rr	rr				
Eunotia lunaris, (Ehrenb.) Grun.	...	rrr	...	...	...	...	...	...	...	..	rr	
,, *gracilis*, (Ehrenb.) Rabenh.	...	...	..	...	...	rrr	rr	rr	...	...	rrr	
,, *biceps*, (W. Sm.)	...	...	...	...	rrr							
Epithemia turgida, (Ehrenb.) Kütz.	...	...	...	...	...	...	rrr					
Gomphonema geminatum, Ag.	...	...	...	...	...	...	...	...	...	...	rrr	
,, *intricatum*, Kütz.	...	...	...	rrr	...	rrr	rr	rr	...	rr	r	
,, ,, var. *Vibrio*, (Ehrenb.) Van Heurck	...	...	...	...	...	...	...	...	...	rrr		
Vanheurckia rhomboides, (Ehrenb.) Bréb., var. *saxonica*, (Rabenh.) G. S. West	...	...	...	...	...	...	...	...	...	rr	r	rr
Cocconema gracile, (Rabenh.) G. S. West	...	...	...	...	...	...	...	...	...	...	rrr	
,, *cymbiforme*, Ehrenb., var. *parvum*, (W. Sm.) Van Heurck	...	...	...	...	...	...	rrr	...	...	...	rr	
Surirella biseriata, Bréb.	...	...	...	...	...	...	rr					
,, *ovalis*, Bréb., var. *angusta*, (Kütz.) Van Heurck	...	...	...	...	...	...	...	...	...	rrr	...	rr
,, *robusta*, Ehrenb., var. *splendida*, (Ehrenb.) Van Heurck	...	rrr	...	rrr	rrr	...	...	...	...	rr	rr	
Phæophyceæ.												
Stichoglœa olivacea. Chodat	..	...	...	...	...	c						
Myxophyceæ.												
Merismopedia glauca, (Ehrenb.) Näg.	...	...	...	...	...	...	...	...	...	...	...	rrr
Aphanocapsa delicatissima, sp. n.	...	...	...	...	...	r						
Flagellata.												
Dinobryon cylindricum, Imhof, var. *divergens*, (Imhof) Lemm.	...	...	...	...	...	...	...	...	...	...	rr	
Peridinieæ.												
Peridinium Willei, Huitf.-Kaas	c	rr	rr	rr	r	r	rr	rrr	rrr	rr	c	cc

Tabellaria fenestrata and *Surirella biseriata*. Much fine detritus was present. Rotifers few.

March 5th, 1909. Temp. of water 41° F. (=5° C.). *Staurastrum jaculiferum* uncommon. Various Diatoms present, but no single species at all dominant. Much fine detritus and vegetable hairs. Rotifers and Entomostraca practically absent.

April 6th, 1909. Temp. of water 40° F. (=4·4° C.). *Staurastrum jaculiferum* rather more frequent. Individuals of various groups of the Protococcales

FIG. 2.

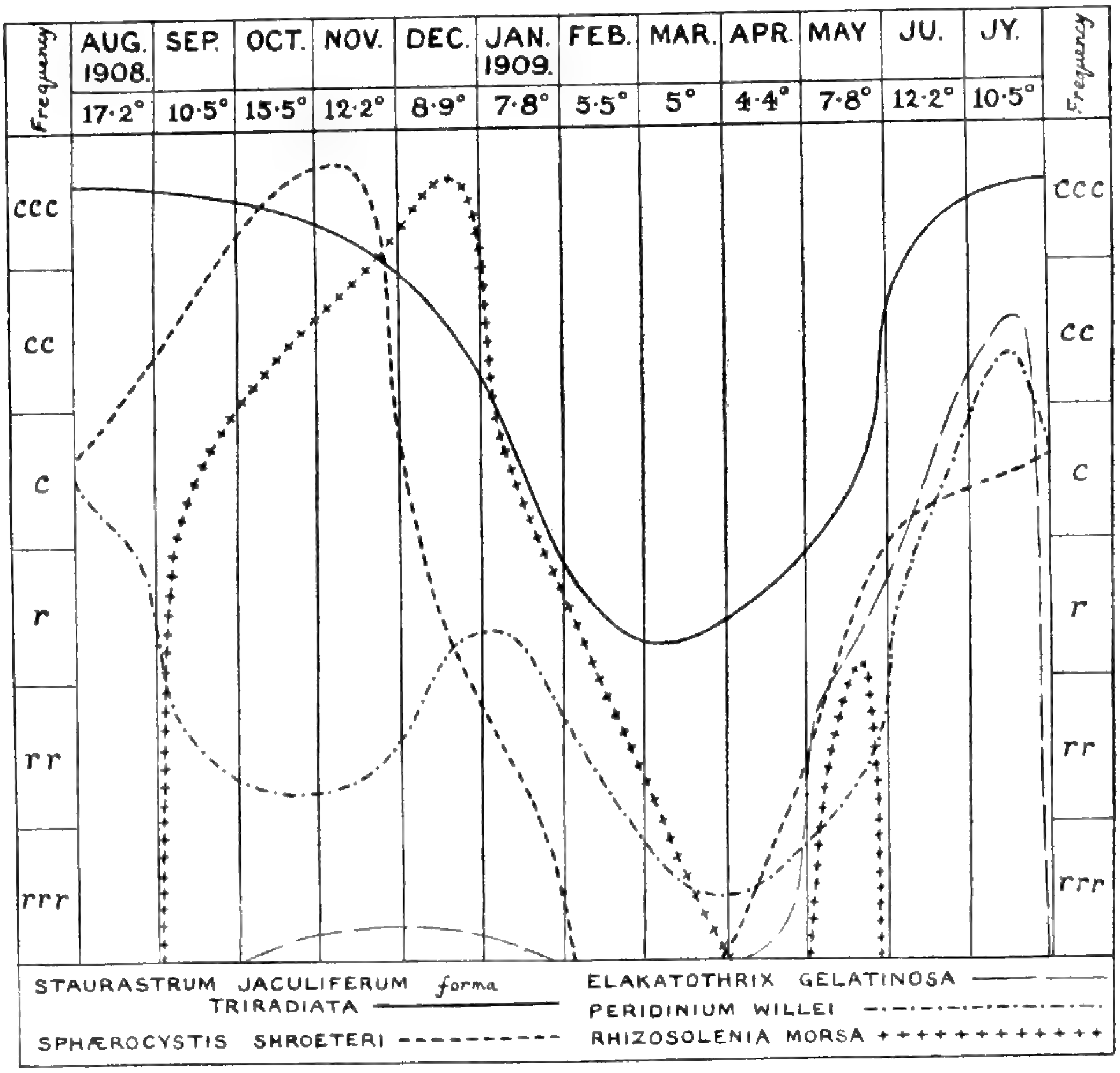


Chart of the periodicity of five of the most conspicuous constituents of the phytoplankton of Wastwater. The temperatures are in degrees Centigrade.

beginning to appear. Diatoms practically absent. Much coarse detritus. Few Rotifers and a few Nauplii.

May 3rd, 1909. Temp. of water 46° F. (=7·8° C.). *Staurastrum jaculi-*

ferum now quite common. Other members of the Chlorophyceæ and also Diatoms increasing in numbers. Rotifers fairly common.

June 4th, 1909. Temp. of water 54° F. (=12·2° C.). The Chlorophyceæ have now attained their maximum abundance, both as regards number of species and number of individuals. *Peridinium Willei* common. Rotifers numerous.

July 5th, 1909. Temp. of water 51° F. (=10·5 C.). *Staurastrum jaculiferum* very abundant. *Elakatothrix gelatinosa* very common and at its maximum. *Peridinium Willei* common. Rotifers abundant.

In Wastwater the chief constituents of phytoplankton are Chlorophyceæ and Diatoms, although *Peridinium Willei* is a conspicuous summer constituent. The total number of species observed from August 1908 to July 1909 was 50, of which 25 (or 50 per cent.) were Chlorophyceæ, 20 (or 40 per cent.) Bacillarieæ, 1 (or 2 per cent.) Phæophyceæ, 2 (or 4 per cent.) Myxophyceæ, 1 (or 2 per cent.) Flagellata, and 1 (or 2 per cent.) Peridinieæ.

Of these constituents only seven became really common, and only four of these were at any time abundant. Thus the actual bulk of phytoplankton is rather small. All the species recorded from the plankton of this lake in September 1906 * were observed in the twelve months under consideration.

The plankton of Wastwater has two fairly distinct phases :—

I. *January–May* (cold period, with vernal rise of temperature) Chlorophyceæ at their minimum ; Diatoms frequent but none dominant.

II. *June–December* (warm period, with autumnal decline of temperature). Chlorophyceæ at their maximum, dominated by great abundance of *Staurastrum jaculiferum*. General maximum of Diatoms in June, although marked by abundance of Chlorophyceæ. *Rhizosolenia morsa* attaining a great maximum in December.

Although 20 species of the Bacillarieæ occur in the plankton of Wastwater, only one of them, *Rhizosolenia morsa*, ever becomes very abundant. This delicate Diatom appears rather suddenly in September and at once gets very numerous, attaining a great maximum in December. It then rapidly declines and disappears in March, appearing again in small quantity in May. It thus reaches its great maximum during the autumn fall in temperature. *Melosira granulata* was one of the rarest constituents of the plankton, and *Asterionella* and the star-dispositions of *Tabellaria* were entirely absent.

Of the Chlorophyceæ, the one outstanding constituent was *Staurastrum jaculiferum*, which occurred in enormous abundance, without any diminution, from June to November. The individuals were very finely developed, with long spines, and even throughout the winter months were not at all infrequent. *Oocystis lacustris* and *Glœocystis gigas* were fairly common in June,

* *Vide* W. & G. S. West, in 'The Naturalist,' April 1909.

and *Sphærocystis Schroeteri* reached a considerable maximum from October to November. The most interesting of all the green constituents, however, was *Elakatothrix gelatinosa*, one of the Protococcales only previously observed by Wille in the lakes of Norway*. So far as we have ascertained, this Alga is not only absent from all the other lakes of the English Lake District, but has not been observed in any other lake in the British Islands. It occurred sparingly during the autumnal fall of temperature, but was abundant in June and July during the vernal rise in temperature.

Peridinium Willei attained its maximum in July, as in Ennerdale Water, but during the period of investigation it was never absent from the plankton and a second smaller maximum occurred from December to January.

On the whole, the phytoplankton of Wastwater is by no means rich. A very minute species of *Aphanocapsa* was present in the January collections, which we have described as a new species—*A. delicatissima*.

3. Windermere, Westmoreland.

The phytoplankton of this body of water, the largest of the English Lakes, has been worked out in detail for a period of 12 months from September 1907 to August 1908 †. It has been shown to have three fairly distinct phases.

I. *January–April* (cold period). *Melosira granulata* phase. During February and March the phytoplankton is at its minimum.

II. *May–July* (vernal rise in temperature). First maximum of *Asterionella gracillima* in May and June.

III. *August–December* (autumnal fall in temperature). The Desmid-phase extends from August to November, and is most noticeable in September and October. In November is a second maximum of *Asterionella gracillima*.

One of the leading features in the periodicity is the double maximum of *Asterionella gracillima*. There is a vernal maximum in May and June, and an equally great autumnal maximum from November to January, both occurring at approximately the same water-temperature (7°–8° C.). *Melosira granulata* attained its maximum in April with a water-temperature of 1·7° C.).

4. Loch Lomond, Dumbartonshire.

This lake is of considerable size, being 21 miles in length and 5 miles in width at its widest part. Although situated between mountains rising to 2000 feet on one side and 3000 feet on the other, it is only 23 feet above sea-

* N. Wille, in Biol. Centralbl. xviii. 1898, p. 2.

† W. & G. S. West, in 'The Naturalist,' 1909, pp. 188–193, 260–266, text-figs. 3 & 4, and pl. 7.

level. The lake-basin consists of outcrops of metamorphic and Devonian rocks. The collections were made to the north-west of Luss at monthly intervals from September 1908 to August 1909.

Sept. 2nd, 1908. Temp. of water 59° F. (=15° C.). A mixed plankton consisting of Chlorophyceæ and Bacillarieæ, with a considerable quantity of *Cœlosphærium Kützingianum.* Among the Chlorophyceæ certain species of *Staurastrum*, such as *St. paradoxum* var. *cingulum*, *St. lunatum* var. *planctonicum*, and others, stood out conspicuously, and *Tetraspora lacustris* and *Ankistrodesmus falcatus* are quite common. The only common Diatoms are *Tabellaria fenestrata* and *T. flocculosa*. Rotifers abundant, but few Copepods.

Oct. 2nd, 1908. Temp. of water 60° F. (=15·5° C.). Very similar to the collections of the preceding month, but with less *Ceratium Hirundinella*, *Cœlosphærium Kützingianum* in great quantity.

Nov. 2nd, 1908. Temp. of water 54° F. (=12·2° C.). Diminution in Chlorophyceæ, more especially in number of Desmids. *Cœlosphærium* still very abundant, but the colonies beginning to dissociate. *Asterionella* and *Tabellaria* fairly common. Copepods numerous.

Dec. 1st, 1908. Temp. of water 49° F. (=9·4° C.). Chlorophyceæ much reduced, although varieties of *Staurastrum paradoxum* are still common. There is a great influx of detritus and a rapid diminution of *Cœlosphærium*. The amount of *Melosira granulata* much increased. Copepods and *Bosmina* fairly common.

Jan. 9th, 1909. Temp. of water 44° F. (=6·6° C.). All the phytoplankton greatly reduced, except the varieties of *Staurastrum paradoxum* and *Melosira granulata*. Few Rotifers, Nauplii, and *Bosmina*.

Feb. 4th, 1909. Temp. of water 43° F. (=6·1° C.). The plankton contains much detritus. Desmids scarcer than in January, but varieties of *Staurastrum paradoxum* not rare. *Melosira granulata* and *Surirella robusta* var. *splendida* both increasing in quantity. Few Rotifers and many Nauplii.

March 2nd, 1909. Temp. 40° F. (=4·4° C.). Less detritus and more phytoplankton in the collections. *Cœlosphærium Kützingianum* increasing in quantity. *Asterionella formosa* common and *Melosira granulata* about as abundant as in February. Desmids present in increased numbers and showing signs of active division. Rotifers few, but plenty of Nauplii and Entomostraca, especially large specimens of *Bosmina*.

April 3rd, 1909. Temp. of water 41° F. (=5° C.). Very great increase in Diatoms, more especially *Melosira granulata* and *Asterionella*. The genera *Eunotia*, *Navicula*, *Surirella*, and *Cyclotella* well represented. Desmids frequent, but obscured by abundance of Diatoms. *Cœlosphærium Kützingianum* common.

May 3rd, 1909. Temp. of water 45° F. (=7·2° C.). Diatoms entirely dominant, more particularly *Melosira granulata*. *Asterionella* not quite so

TABLE OF PHYTOPLANKTON FROM LOCH LOMOND.

The relative frequency is indicated as before.

Species.	1908. September. 59° F. (=15° C.).	October. 60° F. (=15·5° C.).	November. 54° F. (=12·2° C.).	December. 49° F. (=9·4° C.).	1909. January. 44° F. (=6·6° C.).	February. 43° F. (=6·1° C.).	March. 40° F. (=4·4° C.).	April. 41° F. (=5° C.).	May. 45° F. (=7·2° C.).	June. 56° F. (13·3° C.).	July. 60° F. (=15·5° C.).	August. 59° F. (=15° C.).
Chlorophyceæ.												
Œdogonium sp. (sterile)	r	...	...	...	...	rr	r	...	...	rr	rr	r
Mougeotia sp. (sterile)	...	...	...	...	...	...	...	...	...	rrr	...	r
Zygnema sp. (sterile)	...	...	r	...	...	...	...	...	...	...	rr	r
Gonatozygon monotænium, De Bary	...	...	...	...	...	...	...	...	...	...	...	rr
Closterium Kützingii, Bréb.	rr	rr	rr	rrr	...	rr	r	...	...	rr	r	rr
,, *macilentum*, Bréb.	...	...	...	...	rrr	...	rrr	...	rr			
Cosmarium contractum, Kirchn., var. *ellipsoideum*, (Elfv.) W. & G. S. West	rr	rr	rr	...	...	...	...	...	rrr	rr	r	
Xanthidium antilopæum, (Bréb.) Kütz., var. *depauperatum*, W. & G. S. West	...	rr	...	...	..	...	...	rr	...	...	rrr	
,, *subhastiferum*, West, var. *Murrayi*, W. & G. S. West, forma *triquetra*	r	rr	...	...	rrr	rr	rr	rr	rr	rr	r	r
Arthrodesmus triangularis, Lagerh., var *subtriangularis*, (Borge) W. & G. S. West	c	r	rrr	...	rrr	rrr	rrr	rrr	r	r	r	r
Staurastrum lunatum, Ralfs, var. *planctonicum*, W. & G. S. West	c	r	rr	rr	rrr	rrr	rrr	rrr	rrr	rr	r	c
,, *megacanthum*, Lund., var. *scoticum*, W. & G. S. West	r	rr	rr	rr	rrr	rrr	rr	rrr	rrr	rr	rr	r
,, *paradoxum*, Meyen, var. *longipes*, Nordst.	c	r	r	c	r	rr	r	r	rr	r	r	c
,, ,, var. *cingulum*, W. & G. S. West	cc	c	r	r	r	r	r	r	r	c	c	c
Spondylosium planum, nob.	r	rr	rrr	...	...	...	...	rrr	rr	rr	r	c
Hyalotheca mucosa, Ehrenb.	...	...	...	...	...	...	...	...	...	...	...	rr
Scenedesmus bijugatus, (Turp.) Kütz.	rrr											
Ankistrodesmus falcatus, (Corda) Ralfs	c	c	r	...	...	...	rrr	...	rr	rr	r	c
,, ,, *acicularis*, (A. Br.) G. S. West	rrr	rr	...	...	...	...	rrr					
Closteriopsis longissima, Lemm., var. *tropicum*, W. & G. S. West	...	...	...	...	...	rrr						
Oocystis lacustris, Chodat	r	rr	...	...	...	...	...	...	...	r		
Nephrocytium lunatum, West	rrr	...	...	..	...	...	...	...	...	rrr	rr	

Dictyosphærium pulchellum, Wood	...	...	...	...	r							
Botryococcus Braunii, Kütz.	r	r	r	...	...	...	...	...	...	rr	rr	rr
Sphærocystis Schroeteri, Chodat	c	c	rr	rr	rrr	...	rrr	rrr	rr	rr	c	c
Tetraspora lacustris, Lemm.	c	c	r	...	...	...	...	...	r	c	c	c
Glœocystis gigas, (Kütz.) Lagerh.	r	rrr	...	...	...	...	...	...	rr			
Bacillarieæ.												
Melosira granulata, (Ehrenb.) Ralfs	rrr	rr	r	c	c	cc	cc	ccc	ccc	ccc		
Cyclotella compta, Kütz.	c	c	r	rr	rr	rrr	rrr	rr	r	c	r	r
Tabellaria fenestrata, (Lyngb.) Kütz.	c	r	r	rr	rr	rr	rrr	rrr	rr	r	cc	c
,, ,, var. *asterionelloides*, Grun.	c	c	r	rr	rr	rr	rrr	rrr	rrr	c	cc	cc
,, *flocculosa*, (Roth) Kütz.	r	r	rrr	...	...	rrr	rrr	rr	rr	rr	rr	r
Fragilaria capucina, Desmaz.	...	...	...	...	...	...	...	...	rr	r		
Synedra pulchella, Kütz.	...	...	rrr	...	...	...	rrr	rr	r	r	rr	rr
,, *radians*, (Kütz.) Grun.	r	...	...	...	...	rrr	rrr	rr	r	c	rr	
Asterionella formosa, Hass.	c	c	r	r	r	r	c	cc	cc	c	r	r
,, *gracillima*, Heib.	c	c	c	c	r	rr	r	c	cc	ccc	ccc	ccc
Eunotia gracilis, (Ehrenb.) Rabenh.	...	...	...	...	rr	...	rrr	r				
Gomphonema intricatum, Kütz.	...	...	...	...	rrr	...	rrr	rrr				
Navicula radiosa, Kütz.	...	...	...	...	...	...	...	rr				
Surirella biseriata, Bréb.	...	...	...	..	...	...	...	rr	...	...	...	r
,, *robusta*, Ehrenb.	...	...	...	...	...	...	...	rr				
,, ,, var. *splendida*, (Ehrenb.) V. Heurck	rrr	rrr	rrr	rr	r	r	c	c	r	rrr	rrr	rrr
Myxophyceæ.												
Oscillatoria Agardhii, Gomont	rr	rr	...	...	...	rrr	...	...	...	rrr	rrr	rrr
Cœlosphærium Kützingianum, Näg.	ccc	ccc	ccc	r	r	c	cc	cc	cc	cc	cc	ccc
Gomphosphæria aponina, Kütz.	...	...	...	...	r	...	...	...	r			
,, *lacustris*, Chodat	...	...	...	...	...	...	...	...	...	rrr		
Aphanocapsa delicatissima, sp. n.	rr											
Aphanothece nidulans, Richter, var. *endophytica*, var. n.	cc	cc	cc	...	...	...	cc	cc	cc	c	cc	cc
Microcystis elabens, (Bréb.) Kütz.	...	rr	rrr									
,, *Flos-aquæ*, (Wittr.) Kirchn.	...	...	...	...	...	...	...	...	...	...	...	rrr
Flagellata.												
Dinobryon cylindricum, Imhof, var. *divergens*, (Imhof) Lemm.	c											
,, ,, var. *Schauinslandii*, Lemm.	c	r	rr	rrr								
Peridinieæ.												
Ceratium Hirundinella, O. F. Müller	c	r	...	...	...	...	...	...	...	rr	rr	r
Peridinium Willei, Huitf.-Kaas	c	r	...	...	...	...	...	...	rrr	rr	r	r

conspicuous. *Cœlosphærium* very common. Desmids not uncommon, but somewhat masked by abundance of Diatoms. Rotifers very few. Nauplii very rare.

June 2nd, 1909. Temp. of water 56° F. (=13·3° C.). Diatoms still dominant, but the *Melosira*-plankton has given place to a mixed plankton in which *Tabellaria* and *Cyclotella* are common. Increase in the Chlorophyceæ,

Fig. 3.

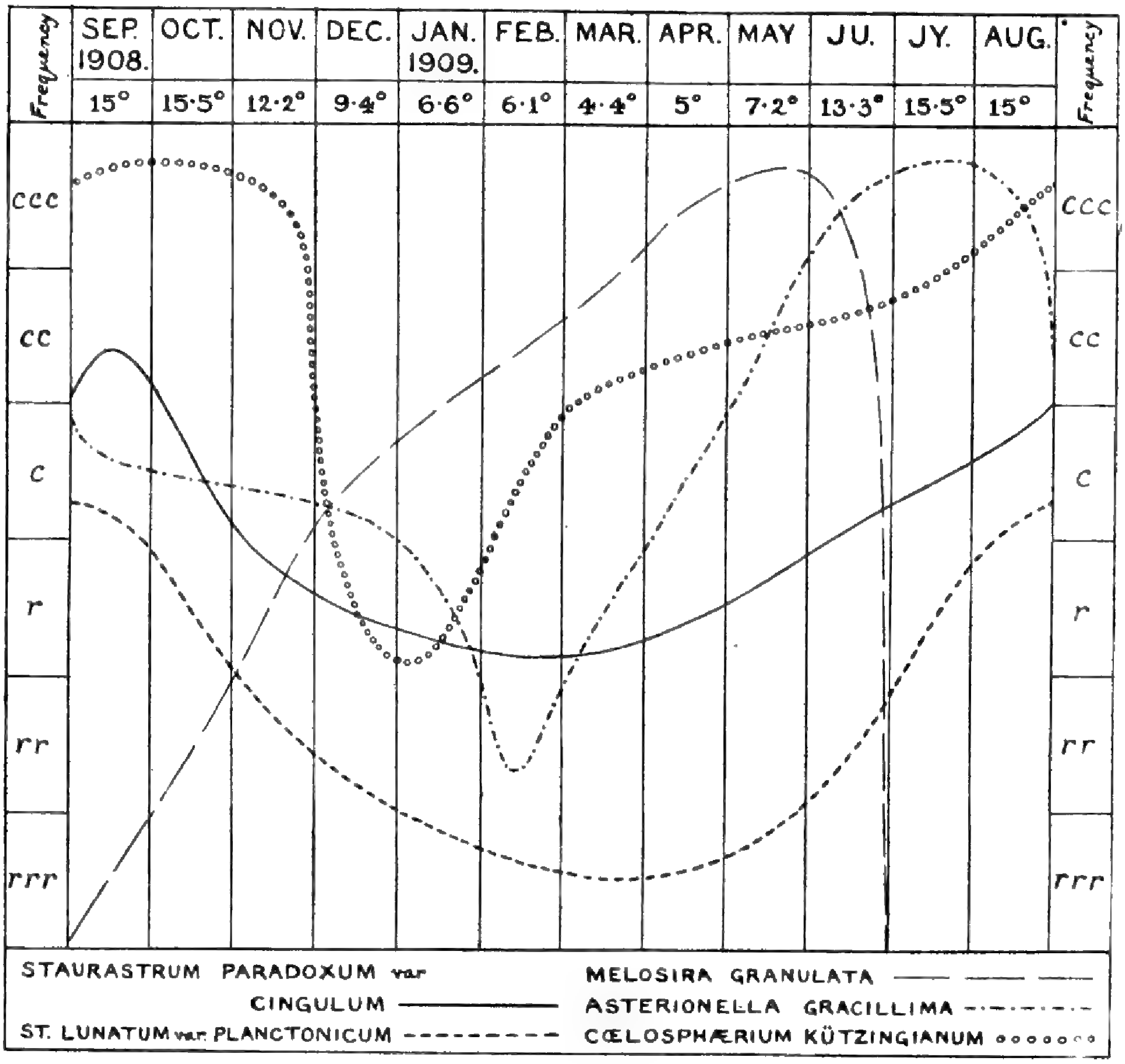


Chart of the periodicity of five of the dominant constituents of the phyloplankton of Loch Lomond. The temperatures are in degrees Centigrade.

including particularly fine specimens of *Tetraspora lacustris*. Both 3-horned and 4-horned forms of *Ceratium Hirundinella* present. Rotifers few. Entomostraca few.

July 3rd, 1909. Temp. of water 60° F. (=15·5° C.). Mixed plankton in which Desmids are much more numerous. Complete disappearance of *Melosira granulata* and diminution of *Asterionella*. Increase in amount of

Tabellaria fenestrata, most of the colonies being transitional to the var. *asterionelloides*. *Cœlosphærium* increasingly abundant, and *Peridinium Willei* in slightly increased amount. Rotifers numerous. Entomostraca few.

Aug. 2nd, 1909. Temp. of water 59° F. (=15° C.). Mixed plankton in which *Cœlosphærium Kützingianum* is the dominant constituent. Desmids more conspicuous, and *Sphærocystis Schroeteri* fairly common. Diatoms numerous, mostly *Tabellaria* and *Asterionella*. Rotifers fairly common. Entomostraca rare.

Loch Lomond has a mixed plankton of Chlorophyceæ and Diatoms, in which quantities of *Cœlosphærium Kützingianum* occur nearly all the year round. The total number of species observed from September 1908 to August 1909 was 50, of which 25 (or 50 per cent.) were Chlorophyceæ, 14 (or 28 per cent.) Bacillarieæ, 8 (or 16 per cent.) Myxophyceæ, 1 (or 2 per cent.) Flagellata, and 2 (or 4 per cent.) Peridinieæ.

There are two more or less distinct phases in the phytoplankton of Loch Lomond :—

I. *December–June* (cold period, with vernal rise of temperature). Chlorophyceæ at their minimum ; Diatoms rapidly increasing in numbers towards the latter end of the period, and culminating in a great maximum of *Melosira granulata* and *Asterionella gracillima*.

II. *July–November* (warm period with autumnal decline of temperature). Chlorophyceæ attain their maximum, along with a great maximum of *Cœlosphærium* and a considerable abundance of certain Diatoms, such as *Tabellaria*.

Of the fourteen species of Bacillarieæ observed in the plankton, seven become more or less common at some period of the year. Two of these, *Asterionella gracillima* and *Melosira granulata*, become dominant: the former from June to August, when it is associated with quantities of *Tabellaria fenestrata* ; and the latter in June, when it occurs in such prodigious quantity that the lake may be described as possessing a *Melosira*-plankton. In both April and May, among the thousands of straight filaments of *Melosira* were a few coiled ones such as those recorded by Ostenfeld * from a lake in Iceland. The two species of *Tabellaria* are most abundant in the summer months, but *Surirella robusta* var. *splendida* attained its maximum in March and April.

Of the Chlorophyceæ, several Desmids were common in July, August, and September, and a few fairly abundant up to November or December. *Ankistrodesmus falcatus* was also common in the autumn. Both *Sphærocystis Schroeteri* and *Tetraspora lacustris* were in considerable abundance from

* C. H. Ostenfeld, in Botanisk Tidsskrift, xxvi. (1904) p. 233, f. 5 (p. 232).

July to October, specimens of the latter being particularly good. The occurrence of these members of the Tetrasporaceæ simultaneously in about equal abundance does not lend support to the view suggested by one of the authors as a result of the examination of Australian material *, viz., that these two plankton-algæ are states of one and the same organism. Rather does it confirm Wesenberg-Lund's observations † that the two are probably distinct.

The Blue-green Alga *Cœlosphærium Kützingianum* is one of the leading constituents of the plankton of Loch Lomond, dominating the whole plankton from August to September. It is never absent at any time of the year, although it is greatly reduced in the cold period when *Melosira granulata* is so abundant. An interesting discovery was the occurrence of an endophytic *Aphanothece* within the mature colonies of the *Cœlosphærium*. On careful scrutiny this *Aphanothece* has been found in other lakes. (Consult p. 432.) The Flagellates and Peridinieæ are only common in the month of September.

5. Loch Katrine, Perthshire.

This well-known Scottish loch is 8 miles in length by three-quarters of a mile in breadth, and is 364 feet above sea-level. Its greatest depth is 495 feet. Towards the eastern end, where the collections were made, the surrounding mountains rise to 2393 feet. The collections were made monthly from August 1908 to July 1909.

Aug. 18th, 1908. Temp. of water 60° F. (=15·5° C.). Varieties of *Staurastrum paradoxum* and *St. cuspidatum* var. *maximum* were very common. *Cœlosphærium Kützingianum* very abundant. Diatoms few and scarce. Rotifers frequent. *Bosmina* very abundant.

Sept. 17th, 1908. Temp. of water 56° F. (=13·3° C.). Very similar in all respects to the August plankton, but containing rather more detritus and fragmentary organic matter.

Oct. 16th, 1908. Temp. of water 55° F. (=12·7° C.). Several species of *Staurastrum* still pretty common. *Cœlosphærium* much reduced in numbers. *Merismopedia tenuissima* common. *Rhizosolenia morsa* makes its appearance. Great increase in amount of fine detritus. No Rotifers and very few Nauplii.

Nov. 17th, 1908. Temp. of water 50° F. (=10° C.). *Staurastra* still numerous. Very little *Cœlosphærium* and with colonies in poor condition. Filaments of *Œdogonium* very common and much finely divided organic matter. *Rhizosolenia morsa* more numerous. No Rotifers or Entomostraca present.

* G. S. West, in Journ. Linn. Soc., Bot. xxxix. (1909) pp. 75, 76.

† C. Wesenberg-Lund, "Studier over de Danske Söers Plankton," Dansk. Ferskv.-Biol. op. 5, Kjöbenhavn, 1904, p. 21 (of Summary).

Dec. 15*th*, 1908. Temp. of water 45° F. (=7·2° C.). *Staurastra* still numerous. Very little *Cœlosphærium*, but a great increase in amount of organic detritus. Sterile *Œdogonium* still common. *Rhizosolenia morsa* fairly frequent, and other Diatoms becoming evident. First appearance of the coiled *Lyngbya contorta*.

Jan. 18*th*, 1909. Temp. of water 43° F. (=6·1° C.). *Staurastrum paradoxum* still fairly common. *Cœlosphærium* distinctly rare and colonies in very poor condition. Much fine detritus and few Diatoms. *Lyngbya contorta* not uncommon. Entomostraca and Nauplii very rare.

Feb. 16*th*, 1909. Temp. of water 40° F. (=4·4° C.). Very similar to the January plankton, but with a larger quantity of *Lyngbya contorta*.

March 16*th*, 1909. Temp. of water 39° F. (=3·9° C.). *Staurastra* becoming more numerous, and also considerable increase in *Cosmarium abbreviatum* var. *planctonicum*. All the Desmids showing active vegetative division. Diatoms uncommon. Much detritus; few Rotifers; and no Entomostraca.

April 18*th*, 1909. Temp. of water 46° F. (=7·7° C.). Desmids numerous, especially *Staurastrum*. *Cœlosphærium* decidedly increased, and Diatoms not uncommon. Rotifers rare; few Nauplii.

May 18*th*, 1909. Temp. of water 46° F. (=7·7° C.). Desmids numerous, especially the typical form of *Staurastrum paradoxum*. No increase in quantity of *Cœlosphærium*. Diatoms moderately abundant. *Lyngbya contorta* entirely disappeared. Rotifers few; Nauplii very numerous.

June 17*th*, 1909. Temp. of water 54° F. (=12·2° C.). Great increase in number of Desmids, so that the plankton has now become a Desmid-plankton, largely composed of a few species of the genus *Staurastrum*. The Chlorophyceæ have reached their maximum, and the Diatoms, although numerous, are not conspicuous. *Rhizosolenia morsa* is again common, and the frustules are considerably wider than in the preceding November and December. Few Rotifers; Nauplii and Crustacea practically absent.

July 16*th*, 1909. Temp. of water 60° F. (=15·5° C.). Plankton rather similar to that of preceding month. Still a Desmid-plankton, but various Chlorophyceæ and *Peridinium Willei* much more numerous, so that the Desmids do not dominate to the extent that they did in June. *Rhizosolenia morsa* abundant, and also a considerable increase in the quantity of *Cœlosphærium Kützingianum*. Few Rotifers. *Bosmina longirostris* not uncommon.

Loch Katrine has a mixed plankton of Chlorophyceæ, Diatoms, and Myxophyceæ. The total number of species observed from August 1908 to July 1909 was 63, of which 35 (or 55·5 per cent.) were Chlorophyceæ, 16 (or 25·6 per cent.) Bacillarieæ, 1 (or 1·5 per cent.) Phæophyceæ, 8 (or 12·8 per cent.) Myxophyceæ, 1 (or 1·5 per cent.) Flagellata, and 2 (or 3·1 per per cent.) Peridinieæ.

TABLE OF PHYTOPLANKTON FROM LOCH KATRINE.

The relative frequency is indicated as before.

Species.	1908. August. 60° F. (=15·5° C.).	September. 56° F. (=13·3° C.).	October. 55° F. (=12·7° C.).	November. 50° F. (=10° C.).	December. 45° F. (=7·2° C.).	1909. January. 43° F. (=6·1° C.).	February. 40° F. (=4·4° C.).	March. 39° F. (=3·9° C.).	April. 46° F. (=7·7° C.).	May. 46° F. (=7·7° C.).	June. 54° F. (=12·2° C.).	July. 60° F. (=15·5° C.).
Chlorophyceæ.												
Œdogonium sp. (sterile)	c	c	rr	c	c	rrr	...	r	rr	rr	r	r
Ulothrix subtilis, Kütz., var. *variabilis*, (Kütz.) Kirchn.	...	...	rr	...	...	rr	rr	rrr	rrr	...	rrr	
Mougeotia sp. (sterile)	rr	...	rrr	...	rrr	rrr	rrr	rr	rr	rr	rr	r
Zygnema sp. (sterile)	rrr	...	...	...	...	...	...	...	...	...	rrr	
Spirogyra sp. (sterile)	...	...	rrr	rrr	...	...	...	...	...	...	r	
Gonatozygon monotænium, De Bary	...	rr	...	...	..	...	...	..	...	...	rr	
Netrium interruptum, (Bréb.) Lütkem.	...	...	...	...	...	...	...	...	...	...	...	rrr
Roya cambrica, W. & G. S. West, var. *limnetica*, var. n.	...	...	rrr	...	...	rrr						
Closterium juncidum, Ralfs	...	...	...	...	rrr							
„ *Kützingii*, Bréb.	...	...	...	...	...	...	...	...	...	...	rrr	
„ *macilentum*, Bréb.	...	...	...	...	...	...	...	...	...	rrr	rrr	
Tetmemorus granulatus, (Bréb.) Ralfs	...	rr										
Euastrum bidentatum, Näg.	...	...	rrr									
„ *crassum*, (Bréb.) Kütz.	...	...	...	rrr								
„ *Didelta*, (Turp.) Ralfs	...	...	...	...	...	...	...	rrr				
Micrasterias papillifera, Bréb.	...	...	..	...	...	...	...	...	...	r		
„ *rotata*, (Grev.) Ralfs	rrr	...	rrr	...	...	rrr	...	...	rrr			
Cosmarium abbreviatum, Racib., var. *planctonicum*, W. & G. S. West	rr	rr	r	r	rr	...	rrr	r	r	r	c	cc
„ *bioculatum*, Bréb.	...	...	rr									
„ *reniforme*, (Ralfs) Arch.	...	...	...	...	...	...	rrr	...	...	...	rrr	rr

Arthrodesmus triangularis, Lagerh.	rrr	...	...	...	...	...	...	...	...	rr	rr	rr
,, ,, var. *subtriangularis*, (Borge) W. & G. S. West	r	r	rr	rr	rrr	...	...	rrr				
Xanthidium armatum, (Bréb.) Rabenh., var. *cervicorne*, W. & G. S. West	rrr											
,, *antilopæum*, (Bréb.) Kütz., var. *depauperatum*, W. & G. S. West	...	...	...	...	...	...	...	...	...	...	rr	
Staurastrum anatinum, Cooke & Wills	...	...	...	...	...	...	...	...	...	...	...	rrr
,, *cuspidatum*, Breb., var. *maximum*, West	c	c	c	r	r	rrr	...	r	r	r	c	c
,, *jaculiferum*, West (forma *triradiata*)	rr	r	r	r	r	rr	rr	c	c	c	ccc	c
,, *paradoxum*, Meyen	rr	r	r	r	rr	rr	r	c	cc	ccc	ccc	ccc
,, ,, var. *cingulum*, W. & G. S. West	ccc	cc	c	cc	c	c	c	c	r	r	r	c
,, ,, var. *longipes*, Nordst.	c	c	c	c	c	r	rr	rrr	rr	r	r	r
Spondylosium planum, (Wolle) nob.	...	rrr	rrr	...	...	...	...	...	rrr	...	r	
Gymnozyga moniliformis, Ehrenb.	...	rrr										
Hyalotheca mucosa, Ehrenb.	...	...	...	...	...	...	...	...	...	...	...	rrr
Ankistrodesmus falcatus, (Corda) Ralfs	...	...	rrr	rrr	...	...	rrr	...	...	...	rrr	rrr
,, ,, var. *acicularis*, (A. Br.) G. S. West	...	...	rrr	...	...	...	rr					
,, ,, var. *spirilliformis*, G. S. West	...	rrr	rrr	rrr	rrr	rrr	...	...	rrr	...	rrr	
Oocystis lacustris, Chodat	...	...	...	...	...	...	...	...	...	...	rr	
Nephrocytium lunatum, West	r	rr	rrr	...	...	...	...	...	rrr	...	...	rr
Sphærocystis Schroeteri, Chodat	rr	rr	rrr	rrr	...	...	...	rrr	rrr	...	rrr	r
Glœocystis gigas, (Kütz.) Lagerh.	...	...	...	...	...	...	...	rrr	...	rrr	rrr	rrr
Bacillarieæ.												
Cyclotella compta, Kütz.	...	...	r	r	rr	rrr	...	...	r	...	r	
Rhizosolenia morsa, W. & G. S. West	...	...	rr	rr	r	r	r	...	...	...	c	cc
Tabellaria fenestrata, (Lyngb.) Kütz.	...	...	...	...	...	...	...	rrr	rr	rr	r	r
,, *flocculosa*, (Roth) Kütz.	rrr	rrr	r	rr	rr	rr	...	r	r	r	c	r
Synedra pulchella, Kütz.	...	rrr	...	...	rrr	rr	rr	...	rr	r	r	
,, *radians*, (Kütz.) Grun.	...	...	c	r	rr	rr	r	r	r	r	r	r
Asterionella gracillima, Heib.	rrr	...	...	rrr	rrr	rrr	rrr	rr	rrr	r	c	r
Eunotia gracilis, (Ehrenb.) Rabenh.	...	...	rrr	...	rrr	...	rrr	...	r			
,, *lunaris*, (Ehrenb.) Grun.	...	...	...	...	...	...	..	rr	...	...	rr	rr
,, *major*, (W. Sm.)	..	...	rr	...	rr							
Gomphonema intricatum, Kütz.	...	...	...	...	rrr	...	...	...	...	rrr		
Navicula major, Kütz	...	...	...	...	rrr	...	...	...	...	...	rr	
,, *viridis*, Kütz.	...	...	...	...	...	rrr						
Vanheurckia rhomboides, Bréb., var. *saxonica*, (Rabenh.) G. S. West	...	...	...	...	...	rrr	rr	rrr				
Surirella biseriata, Bréb.	...	...	...	...	...	rrr	...	rrr	...	...	rrr	
,, *robusta*, Ehrenb., var. *splendida*, (Ehrenb.) Van Heurck	...	...	...	rr	...	...	...	...	...	...	rr	

Phytoplankton from Loch Katrine (*continued*).

Species.	1908.					1909.						
	August. 60° F. (=15·5° C.).	September. 56° F. (=13·3° C.).	October. 55° F. (=12·7° C.).	November. 50° F. (=10° C.).	December. 45° F. (=7·2° C.).	January. 43° F. (=6·1° C.).	February. 40° F. (=4·4° C.).	March. 39° F. (=3·9° C.).	April. 46° F. (=7·7° C.).	May. 46° F. (=7·7° C.).	June. 54° F. (=12·2° C.).	July. 60° F. (=15·5° C.).
Phæophyceæ.												
Stichoglœa olivacea, Chodat	...	...	...	...	...	...	...	...	rr	r	r	r
Myxophyceæ.												
Lyngbya contorta, Lemm., forma	...	...	...	...	rr	rr	r	rr	rrr			
Oscillatoria Agardhii, Gomont	...	...	...	...	...	...	...	...	...	r	rr	
Merismopedia glauca, (Ehrenb.) Näg.	...	...	rrr	...	...	...	...	rrr				
,, *tenuissima*, Lemm.	...	rr	c	r	rr	rrr	...	...	...	...	rrr	r
Cœlosphærium Kützingianum, Näg.	ccc	ccc	c	c	r	rr	rr	rrr	rr	r	r	cc
Aphanocapsa delicatissima, sp. n.	...	...	...	...	...	...	...	...	...	...	...	rrr
Aphanothece nidulans, Richter, var. *endophytica*, var. n.	r	c	c	r	rr	...	...	...	...	...	...	rr
Microcystis Flos-aquæ, (Wittr.) Kirchn.	...	...	...	...	...	...	...	...	...	...	rrr	
Flagellata.												
Dinobryon cylindricum, Imhof	...	...	...	...	...	...	...	...	..	rr	rrr	rrr
,, ,, var. *divergens*, (Imhof) Lemm.	..	...	...	...	...	...	...	...	...	...	rr	r
Peridinieæ.												
Peridinium inconspicuum, Lemm.	...	...	...	...	...	...	...	...	...	...	r	r
,, *Willei*, Huitf.-Kaas	r	rrr	...	...	...	...	..	rr	r	c	cc	ccc

The phases of the plankton of Loch Katrine, although distinct, are difficult to demarcate. It seems best to subdivide the year into three periods, as follows :—

I. *December–March* (cold period, with continuous fall in temperature). Amount of phytoplankton small. Minimum of Chlorophyceæ and rapid diminution of *Cœlosphærium* up to the middle of March. After February, Desmids and *Peridinium Willei* begin to increase rapidly. *Rhizosolenia morsa* has a first maximum from December to February, and then disappears.

Fig. 4.

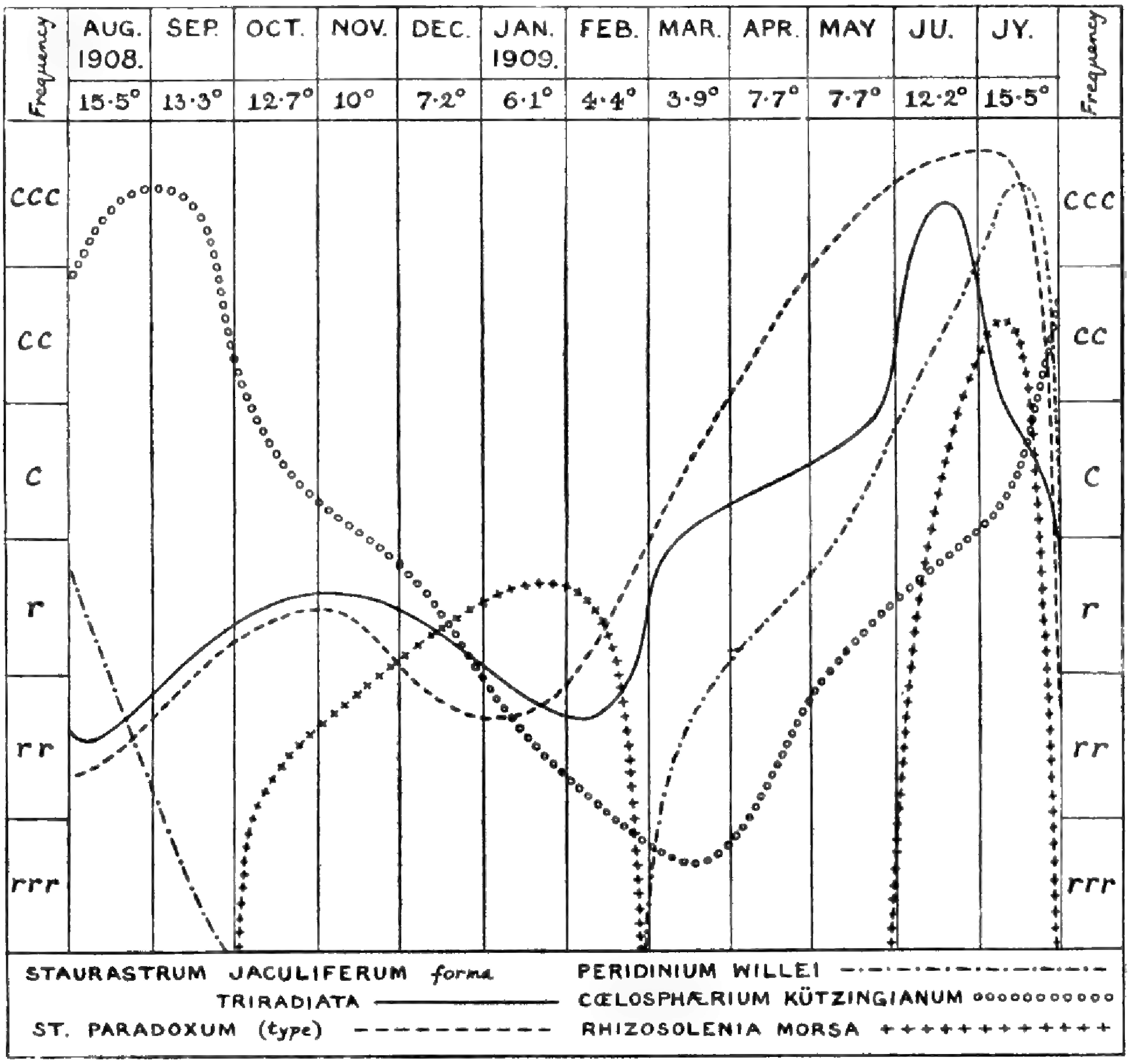


Chart of the periodicity of five of the dominant constituents of the phytoplankton of Loch Katrine. The temperatures are in degrees Centigrade.

II. *April–July* (continuous rise in temperature). Great increase in Desmids and in *Peridinium Willei*. In June and July there is a striking Desmid-plankton. *Rhizosolenia morsa* appears again abundantly in June, and attains a second maximum in July. *Cœlosphærium* rapidly increasing in amount.

III. *August–November* (autumnal fall in temperature). *Cœlosphærium* attains its maximum and dominates the plankton in August and September, after which it rapidly decreases in amount. *Peridinium Willei* disappears in the latter month. Slight maximum of some Desmids from September to November.

Of the 16 species of Bacillarieæ, *Synedra radians* is common in October, *Tabellaria flocculosa* and *Asterionella gracillima* are both common in June, and *Rhizosolenia morsa* attains a considerable maximum in June and July. The latter has also a smaller maximum from December to February, disappearing entirely from the plankton from the end of February to the beginning of June. All the other Diatoms are relatively rare.

Of the Chlorophyceæ only the Desmids are of importance. A sterile species of *Œdogonium* was common in the autumn, but all other Green Algæ except Desmids are at all times comparatively scarce. The most abundant of the Desmids was *Staurastrum paradoxum* and its vars. *cingulum* and *longipes*, but *St. cuspidatum* var. *maximum* and *Cosmarium abbreviatum* var. *planctonicum* also occurred in great quantity in the warmer months.

The Myxophyceæ were represented by 8 species, of which *Cœlosphærium Kützingianum* alone occurred in great quantity. This Alga was never absent from the plankton, and at the time of its great maximum in August and September is the dominating constituent. As in the case of Loch Lomond, the colonies possessed the endophytic *Aphanothece nidulans* var. *endophytica*. Special attention should be called to a form of *Lyngbya contorta* which occurred only in the cold period from December to April, and was most abundant in February. *Merismopedia tenuissima* was common in October.

Of the flagellated organisms, *Peridinium Willei* occurs in great abundance in June and July, but is entirely absent during the fall in temperature from October to February.

6. Loch Earn, Perthshire.

This lake, which is situated at 317 feet above sea-level, is 7 miles in length and rather more than half a mile in breadth. The surrounding mountains vary from about 2000 feet to 3224 feet (Ben Voirlich), and the shores of the lake consist of gravel and drift. The area of the lake is 3·91 square miles ; its main depth is 137·8 feet, and its greatest depth 287 feet.

Owing to unforseen accidents collections were obtained from this lake only on three occasions.

Aug. 21*st*, 1908. Temp. of water 60° F. (=15·5° C.). Mixed plankton containing numerous Desmids and an abundance of *Ceratium Hirundinella*. *Staurastrum cuspidatum* var. *maximum* was particularly common, and quantities of *Cœlosphærium* were present.

Dec. 10th, 1908. Temp. of water 45° F. (=7·2° C.). Material contained a large amount of fine detritus. Few Desmids and few Diatoms present. Most probably this collection was improperly obtained.

Jan. 22nd, 1909. Temp. of water 41° F. (=5° C.). Very dirty material, similar to previous collection.

TABLE OF PHYTOPLANKTON FROM LOCH EARN.

SPECIES.	Aug. 1908. 60° F. (=15·5° C.)	Dec. 1908. 45° F. (=7·2° C.)	Jan. 1909. 41° F. (=5° C.)
Chlorophyceæ.			
Œdogonium sp. (sterile)	r		
Spirogyra sp. (sterile)	rr		
Cosmarium abbreviatum, Racib., var. *planctonicum*, W. & G. S. West	c	...	rr
,, *granatum*, Bréb.	...	...	rrr
Staurastrum cuspidatum, Bréb., var. *maximum*, West	cc	r	r
,, *jaculiferum*, West, forma *biradiata*	r	rrr	rrr
,, *lunatum*, Ralfs	r		
Spondylosium planum, (Wolle) nob.	rrr		
Nephrocytium lunatum, West	rr		
Dictyosphærium pulchellum, Wood	rrr		
Sphærocystis Schroeteri, Chodat	rrr	...	rrr
Bacillarieæ.			
Tabellaria fenestrata, (Lyngb.) Kütz.	rrr		
,, *flocculosa*, (Roth) Kütz.	r	...	rr
Synedra Acus, (Kütz.) Grun.	r		
,, *Ulna*, (Nitzsch) Ehrenb.	rr	rrr	
Eunotia lunaris, (Ehrenb.) Grun.	r		
Gomphonema intricatum, Kütz.	r		
Vanheurckia rhomboides, Bréb., var. *saxonica*, (Rabenh.) G. S. West	r		
Cocconema cymbiforme, Ehrenb.	r		
Surirella biseriata, Bréb.	r		
Myxophyceæ.			
Oscillatoria Agardhii, Gomont	r		
Cœlosphærium Kützingianum, Näg.	cc	r	rr
Gomphosphæria lacustris, Chodat	rrr		
Aphanothece nidulans, Richter, var. *endophytica*, var. n.	c	rr	rr
Peridinieæ.			
Ceratium Hirundinella, O. F. Müller	c		
Peridinium Willei, Huitf.-Kaas	rr		

It is to be regretted that the collections from Loch Earn were not much more complete, as it is impossible from the available material to draw any conclusions regarding the periodicity of the phytoplankton.

7. Loch Lubnaig, Perthshire.

This loch is 4½ miles in length by about half a mile broad at its widest part, and is 405 feet above sea-level. On its western side is Ben Vane (2685 feet), and on its eastern side Beinn Each (2660 feet), the summits of these mountains being about two miles from the lake.

The collections from this lake were also incomplete, but as they were made from August to October 1908 and from January to April 1909, it is possible to form some idea of the periodicity of the phytoplankton.

Aug. 15*th*, 1908. Temp. of water 61° F. (=16·1° C.). The plankton consisted mostly of *Dinobryon cylindricum* and *Anabæna Flos-aquæ*, amongst which were numerous Rotifers and much organic detritus.

Sept. 16*th*, 1908. Temp. of water 54° F. (=12·2° C.). The material consisted almost entirely of Entomostraca. *Tabellaria flocculosa* and *Dinobryon cylindricum* were present in small quantity, and there was a little organic detritus.

Oct. 16*th*, 1908. Temp. of water 56° F. (=13·3° C.). Much organic detritus and broken sterile filaments of *Œdogonium*. Very few Diatoms, and few Rotifers and Entomostraca.

Jan. 20*th*, 1909. Temp. of water 34° F. (=1·1° C.). Plankton practically absent, collection consisting of organic detritus, but we doubt whether the material was collected in a proper manner. Two or three species of Diatoms were observed, and one or two specimens of Rotifers and Crustacea.

Feb. 21*st*, 1909. Temp. of water 36° F. (=2·2° C.). Scarcely any phytoplankton, but much organic and mineral detritus. A few species of Diatoms. No Rotifers. Defective material?

March 16*th*, 1909. Temp. of water 36° F. (=2·2° C.). Phytoplankton mostly Diatoms, of which *Surirella biseriata* and *Tabellaria flocculosa* were most conspicuous. A few species of Desmids were also present in small quantity. Very few Rotifers.

April 20*th*, 1909. Temp. of water 44° F. (=6·6° C.). Phytoplankton mostly Diatoms, of which *Tabellaria fenestrata* is dominant and *T. flocculosa* less abundant. *Synedra Ulna* was common, and many of the valves were curiously bent and deformed. *Dinobryon cylindricum* and *Ulothrix zonata* were both frequent. Few Rotifers were present, and there was a great admixture of organic detritus.

Altogether 37 species were observed in the phytoplankton of Loch Lubnaig, mostly Green Algæ and Diatoms. Most of the Chlorophyceæ occurred in the August collection, whereas the Diatoms were most numerous and in greatest variety in March. The data at our disposal are at present, however, insufficient to enable us to make any definite statement regarding the periodicity of the phytoplankton of this lake.

Table of Phytoplankton from Loch Lubnaig.

Species.	1908. Aug.	1908. Sept.	1908. Oct.	1909. Jan.	1909. Feb.	1909. Mar.	1909. Apr.
Chlorophyceæ.							
Œdogonium sp. (sterile)	rr	rr	c	...	rr	rrr	rr
Ulothrix zonata, (Web. & Mohr) Kütz.	...	...	...	...	...	...	r
,, *subtilis*, Kütz., var. *variabilis*, (Kütz.) Kirchn.	...	...	...	rrr	rrr		
Spirogyra sp. (sterile)	r	...	rr				
Mougeotia sp. (sterile)	r	...	...	...	...	rr	rrr
Gonatozygon monotænium, De Bary	r						
Closterium Kützingii, Bréb.	...	...	...	...	...	rrr	
Euastrum bidentatum, Näg.	...	...	...	...	...	rrr	
Micrasterias denticulata, Bréb.	...	...	...	...	...	rrr	
Cosmarium ochthodes, Nordst.	...	...	...	...	...	rrr	
Xanthidium antilopæum, (Bréb.) Kütz., var. *depauperatum*, W. & G. S. West	r						
Hyalotheca mucosa, Ehrenb.	rrr	...	...	...	...	rrr	
Gymnozyga moniliformis, Ehrenb.	rrr						
Glœocystis gigas, (Kütz.) Lagerh.	c						
Bacillarieæ.							
Tetracyclus lacustris, Ralfs, var. *emarginata*	...	...	...	...	...	rrr	
Tabellaria fenestrata, (Lyngb.) Kütz.	r	...	...	rrr	...	rr	c
,, *flocculosa*, (Roth) Kütz.	c	rr	rrr	rrr	r	c	r
Synedra radians, (Kütz.) Grun.	...	...	...	...	...	r	rrr
,, *Ulna*, (Nitzsch) Ehrenb.	...	...	rr	rrr	r	r	c
Asterionella gracillima, Heib.	...	...	...	...	...	rrr	
Ceratoneis Arcus, (Ehrenb.) Kütz., var. *Amphioxys*, (Rabenh.) De Toni	...	...	...	...	rrr	...	rrr
Eunotia gracilis, (Ehrenb.) Rabenh.	...	...	...	...	...	rrr	
,, *pectinalis*, (Kütz.) Rabenh.	...	...	rr	...	...	rr	rrr
,, *lunaris*, (Ehrenb.) Grun.	...	...	...	...	rr	rr	rr
Gomphonema constrictum, Ehrenb.	...	...	...	...	...	rr	
,, *intricatum*, Kütz.	...	...	...	...	...	rrr	rr
Navicula major, Kütz.	...	...	...	rrr	...	rrr	
Vanheurckia rhomboides, Bréb., var. *saxonica*, (Rabenh.) G. S. West	...	...	...	...	...	rrr	
Cocconema cuspidatum, (Kütz.) G. S. West	...	...	...	...	...	rrr	
Nitzschia Sigma, (Kütz.) W. Sm.	...	...	...	...	...	rr	
Surirella biseriata, Bréb.	...	...	...	rrr	...	r	rrr
,, *linearis*, W. Sm.	...	...	...	...	...	rr	
Myxophyceæ.							
Anabæna Flos-aquæ, (Lyngb.) Bréb.	c						
Oscillatoria Agardhii, Gomont	rrr	...	...	...	..	rrr	rr
Flagellata.							
Dinobryon cylindricum, Imhof	c	rr	...	...	...	rr	r
Synura uvella, Ehrenb.	...	...	...	...	...	rr	rr
Peridinieæ.							
Peridinium Willei, Huitf.-Kaas	rr						

General Conclusions concerning the Phytoplankton of British Lakes and its Periodicity.

The following conclusions are not merely drawn from the data afforded by the collections from the seven lakes previously described, but also from our observations on the plankton of dozens of other lakes in all the lake-areas of the British Islands.

The coldest water-temperatures occur from February to April and are frequently met with in the month of March. The highest temperatures of the water are as a rule in July and August.

The greatest actual bulk of plankton occurs when the Entomostraca are most abundant, but the greatest amount of phytoplankton is found in the late summer and autumn, during the autumnal decline in temperature.

In all the lakes examined there are certain more or less well-marked phases in the phytoplankton, each phase dominated by one or more of the constituents. It is not an easy matter to compare the phytoplankton of one lake with that of another, as the annual phases of one probably do not correspond with those of the other. Take three of the English lakes—Ennerdale Water, Wastwater, and Windermere; Ennerdale Water has 91 species in the phytoplankton, Wastwater 50 species, and Windermere 65 species; yet only 15 species are common to all three lakes, and the dominant species are for the most part different.

Chlorophyceæ.—Almost all the Green Algæ attain their maximum vegetative abundance during the autumnal fall in temperature.

a. *Desmidiaceæ*. The Desmid-phase is during the decline in temperature from August to November, and they are most abundant in September (more rarely in August), although in some lakes certain species reach their maximum in June. The plankton Desmids appear to require very similar physiological conditions, and the maximum vegetative activity of the group as a whole is just after the highest temperature has been reached: that is, in September, or in some cases in early October. In some lakes certain species are perennial, but these also have their maximum at the same season as the others. We have previously pointed out that this is approximately the period of abundance of Desmids in the littoral region and in the bogs *.

b. *Protococcales*. Of this group there are few genera of importance in the plankton, and the frequent pond species of *Scenedesmus*, *Pediastrum*, and *Crucigenia* are very uncommon except in the shallower and more lowland lakes. *Sphærocystis Schroeteri* and *Dictyosphærium pulchellum* are mostly summer and autumn constituents in the larger lakes. *Elakatothrix gelatinosa*,

* W. & G. S. West, in 'The Naturalist,' May 1909, p. 192.

which is found only in Wastwater, and *Tetraspora limnetica*, which occurs only in Ennerdale Water, are both summer forms. *Botryococcus Braunii* is not often abundant in the British lakes and is a late summer form.

BACILLARIEÆ.—Only in the more contaminated lakes do the Diatoms attain great maxima comparable to the vast quantities which periodically appear in many of the central European lakes. The Pennate Diatoms are much more numerous, and for the most part much more conspicuous than the Centric Diatoms.

The evidence at present available shows that although many of the plankton-species of Diatoms occur in greatest quantity in the spring, some of them attain their maxima in the summer and autumn, and several of them have a double maximum, one in the spring and the other in the autumn. An instance of the latter is afforded by *Asterionella gracillima* in Windermere *, in which the spring maximum is of greater bulk but not so prolonged as the autumn maximum.

The double maximum (spring and autumn) of Diatoms in general does not appear to be so marked in the freshwater plankton as in the marine plankton †, and the double maximum of the *same species*, as instanced by *Asterionella gracillima*, *Cyclotella compta*, *Rhizosolenia morsa*, and others, is of unusual interest.

A number of the freshwater Diatoms are perennial constituents of the plankton of certain lakes and can be obtained in a living condition all the year round. Some of them attain their maxima in the spring and others in the autumn, and sometimes in both.

The occurrence of *Rhizosolenia morsa* is very interesting. It apparently had a double maximum in four of the lakes examined. In Ennerdale Water it had a small maximum in April (water-temperature 5·5° C.), and a much larger one from October to November (10°–8·3° C.); in Windermere it was rare in May (4·4° C.) and very rare in September (14·4° C.), not occurring in any other months; in Wastwater there was a small spring maximum in May (7·8° C.) and a large maximum in December (8·9° C.), in Loch Katrine there was a moderate January–February maximum (6·1°–4·4° C.) and a larger July maximum (15·5° C.). The fact that the autumn maximum is the larger is of interest in comparison with the marine plankton of Western Europe, in which the autumn maximum of Diatoms consists largely of species of the genus *Rhizosolenia*. Of interest, also, is the occurrence of this same species in the Yan Yean Reservoir, Victoria, with only one

* We have already discussed this double maximum (*cf.* W. & G. S. West, *l. c.* 1909, pp. 193, 260, and 261), which has likewise been observed in *Fragilaria crotonensis* by Wesenberg-Lund ('Plankton Investigations of Danish Lakes,' Copenhagen, 1908, p. 50).

† Consult Herdman, Presidential Address to the Linnean Society, Proc. Linn. Soc. 1908, pp. 23, 24; also Herdman & Riddell, in Trans. Biol. Soc. Liverpool, xxv. 1911, pp. 63-65.

maximum, which occurs when the temperature of the water is at its highest (23·3° C.) *.

Melosira granulata is equally interesting in its occurrence, sometimes appearing in such quantity as to give a *Melosira*-phase to the plankton. In Windermere it has a large maximum in April (1·7° C.); in Loch Lomond the maximum is from May to June (5°–13·3° C.). On the other hand, in the plankton of the Yan Yean Reservoir, Victoria, *Melosira granulata* attained its maximum abundance in the middle of the warm period with a water-temperature of 21° C.

The apparent erratic increase of the two above-mentioned Diatoms in relation to the water-temperatures would appear to lend support to Whipple's conclusion that temperature is of so little importance to Diatoms that it does not affect their seasonal distribution †. But in contrast to this, it is a matter of common observation that most Diatoms, even the Centric ones, have a decided preference for cool or even cold water, and that many of the plankton Diatoms attain their maxima with much constancy between certain limits of temperature. So that taking into consideration the multitude of observations on the occurrence of Diatoms in relation to the temperature, we are compelled to agree with Kofoid ‡ that there are times when temperature is more important than food as a factor controlling the growth of Diatoms.

MYXOPHYCEÆ.—Most of the Blue-green Algæ are warm-period forms, occurring in greatest abundance in the early part of the autumnal decline in temperature. The only species which occurs in sufficient quantity to become dominant is *Cœlosphærium Kützingianum* §, and this constituent occurs principally in the slightly contaminated lakes, such as Windermere, Loch Lomond, Loch Katrine, and others ‖. Sometimes *Gomphosphæria lacustris* is fairly abundant in some of the low-lying lakes, and in one instance presented a considerable August maximum.

Species of *Anabæna*, *Aphanizomenon*, *Oscillatoria*, etc. are for the most part only of secondary importance in the British lakes, attaining great maxima only on those sporadic occasions which are signalized by great masses of "water-bloom." This phenomenon, which does not occur in the deep, uncontaminated lakes, yet requires thorough investigation, and it would appear that its complete scientific explanation can only be obtained by simultaneous biological and chemical observations extending over a considerable period of time (probably 15–20 years).

* G. S. West, in Journ. Linn. Soc., Bot. xxxix. 1909, p. 21.

† G. C. Whipple, in Technol. Quart. vii. 1894, p. 214.

‡ C. A. Kofoid, "The Plankton of the Illinois River," Bull. Ill. State Labor. Urbana, Illinois, viii. article 1, May 1908, p. 54.

§ *Gomphosphæria Nägeliana* may occur in quantity in some of the slightly contaminated lakes, sometimes mixed with *Cœlosphærium Kützingianum* or even entirely replacing that species.

‖ Such as Lough Neagh.

PERIDINIEÆ.—*Ceratium Hirundinella*, which is so ubiquitous in almost every part of the world, occurs only in certain lakes of the British lake-areas. It occurs in most of the English lakes, but is entirely absent from Wastwater, and very probably absent from Buttermere and Crummock Water. It is also a notable absentee from the larger lakes of North Wales.

When this Peridinian does occur, it is a summer form with a small maximum in August or September. It completely disappears from the plankton in the winter months, entering into an encysted state in December in the larger lakes, or earlier in the smaller bodies of water *, and re-appearing about April or May. In the lakes of more southern climates it is a perennial constituent of the plankton †. We have not seen any seasonal form-variations of this organism such as those described by Wesenberg-Lund from the Danish lakes ‡, although several forms frequently occur simultaneously in some of the lakes.

Ceratium cornutum is a similar summer form.

Peridinium Willei is the most abundant and widely-distributed species of the genus in the English and Welsh lakes, and in some of the Scottish lakes. It is a summer form, with a considerable maximum at some period from July to September, and, as in the case of *Ceratium Hirundinella*, it is a perennial constituent of the lake-plankton of more southern latitudes.

Species of *Peridinium*, like many Diatoms, do not attain a universal maximum at one definite period of the year, but the various species reach their greatest vegetative development at different times of the year §. In some of the pools of the English Midlands there is a summer species (a var. of *P. cinctum*), a spring species (*P. anglicum*), and a very early spring—almost a winter—species (*P. aciculiferum*), each of which has been shown to form resting-cysts at the close of the vegetative period, even though the vegetative periods are all at different seasons.

* * * * * * * * *

In studying the phytoplankton of lakes difficulties of comparison are everywhere met with, even when dealing with lakes in the same area. The constituents of the phytoplankton are not the same in all, and species which occur abundantly in one lake may not occur in any of the others.

* G. S. West, "A Biol. Investigation of the Peridin. of Sutton Park, Warwicksh.," New Phytologist, viii. 1909, p. 193.

† Brahm & Zederbauer, in Verhandl. der k. k. zool.-bot. Ges. Wien, 1904, p. 48; G. Entz, in Result. der wiss. Erforschung des Balatonsee, Bd. ii. Budapest, 1904; Lemmermann, in Archiv für Hydrobiol. u. Planktonkunde, iii. 1908, p. 379.

‡ Wesenberg-Lund, 'Plankton Investigations of Danish Lakes,' Copenhagen, 1908, p. 69.

§ G. S. West, in 'New Phytologist,' viii. 1909, p. 194, f. 126.

These differences in the constituents are partly territorial and partly local, and are in part due to the rigorous conditions which govern the distribution of so many of the purely aquatic Algæ. We have already shown by a carefully collated mass of evidence that a territorial distinction occurs in those lakes situated in drainage-basins in which the rocks are older than the Carboniferous. Some of these lakes possess a Desmid-flora in the plankton such as does not occur in any lakes which are situated in basins of newer formations. Local differences between two lakes in similar basins are frequently due to contamination of the water, some groups of Algæ thriving under such circumstances whereas others are greatly reduced or eliminated.

The varying nature of the plankton of different lakes is to be correlated with the fact that the various groups of Algæ require different physiological conditions for rapid multiplication. For instance, the factors which favour the prolific growth of Desmids are not those which enable an equally rapid increase in the majority of Diatoms; and likewise those factors which favour the great multiplication of one species of Diatom are not favourable for a similar increase in another.

A careful study of the constituents of the phytoplankton in relation to the lake-basins has convinced us that *the factor of greatest importance in both the qualitative and quantitative distribution of plankton is the amount of dissolved salts present in the water.* The highest percentage of dissolved salts is found in those lakes which are slightly contaminated from adjacent villages and farms, and we have before remarked upon the greater quantitative bulk of the plankton of such lakes *.

Slightly contaminated lakes contain a greater number of Diatoms than uncontaminated lakes, and as a rule some of them are perennial constituents of the plankton. A few species frequently have enormous maxima, particularly *Asterionella gracillima*, *Tabellaria fenestrata* var. *asterionelloides*, and *Melosira granulata*, such maxima being probably due to the abundance of nitrates. The Desmida-flora of these lakes is usually poor, and few species ever occur in quantity.

On the other hand, *uncontaminated lakes* (or lakes with very pure water) contain fewer Diatoms, and such as do occur in the plankton rarely attain even a small maximum. The Desmids are generally numerous and there is often a rich Desmid-plankton. The lakes of the Carnarvonshire mountains are excellent examples, being amongst the least contaminated of all the British lakes. Hence in these lakes there are relatively few Diatoms (only 11·1 per cent. out of a total of 162 species) and many Desmids (62·4 per cent.), and some of them possess a very rich Desmid-plankton.

* W. & G. S. West, in Proc. Roy. Soc. B, vol. lxxxi. 1909, p. 175; 'Naturalist,' Sept. 1909, p. 330.

Lakes which possess a mixed plankton of Diatoms and Desmids are probably of an intermediate character with regard to the nature and amount of the dissolved salts in the water. The Myxophyceæ are to a great extent absent from the lakes with very pure water, but an examination of the occurrence and distribution of the plankton-species of Blue-green Algæ indicates that the factors which control their relative abundance are somewhat different from those which govern the prolific occurrence of Diatoms.

There is also a considerable reduction in the amount of *Asterionella* and of the star-dispositions of *Tabellaria*, or even an entire absence of them from lakes with pure water. These two genera of Diatoms are absent from the large African lakes, most probably owing to too high a temperature of the water *, but their absence from certain British lakes appears to be directly concerned with purity of the water. Wastwater furnishes a good example of a lake from which these star-dispositions of the frustules of Diatoms are absent.

The comparative and periodic study of the plankton of the British lakes has afforded evidence in the elucidation of the fact which we first definitely mentioned in 1905 †, and subsequently expounded at greater length ‡, namely, that "the rich Desmid-areas correspond with the Precambrian and Older Palæozoic outcrops (together with the intrusive Igneous material)." It is the occurrence of a rich Desmid-plankton only in those lakes which are least contaminated, and have the purest water, which has led us to the conclusion that the principal factor controlling the abundance of Desmids is the nature and amount of the dissolved salts in the water. Hence it becomes obvious why the rich Desmid-areas should be on the old formations, as for the most part the drainage-water of such areas contains much less in the way of dissolved mineral salts than that of areas of the newer formations. This is due in a great measure to the relative hardness of these rocks, which in itself is due to their antiquity, and also partially to the comparative absence of lime, a substance which is distinctly unfavourable to the growth of the majority of Desmids.

It must, however, be emphasized that not all the lakes of one of these rich Desmid-areas contain a rich Desmid-plankton. Some are too much contaminated by the sewage from farms and villages, and others which may have no such contamination, but yet have no Desmid-plankton, probably receive drainage-water which percolates through certain strata from which too much mineral matter is removed in solution.

Thus the comparative richness of the Desmid-flora of the various parts of

* G. S. West, in Journ. Linn. Soc., Bot. xxxviii. 1907, p. 84.
† W. & G. S. West, in Trans. Roy. Soc. Edin. xli. part 3, 1905, p. 515.
‡ W. & G. S. West, in Proc. Roy. Soc. B, vol. lxxxi. 1909, pp. 195–201.

the British Islands is very largely (but not entirely) dependent upon the presence of the requisite physiological conditions for the growth of these plants, such conditions being in all probability determined by the degree of concentration of the dissolved salts in the water.

It seems likely that with our present knowledge of the occurrence and distribution of British Desmids the whole matter could be definitely settled by a careful and exact chemical investigation of the waters of the lake-areas, both of the lakes and the bogs.

Description of some New Forms found in the Phytoplankton.

The following new forms have been observed during the foregoing investigation :—

1. Roya cambrica, W. & G. S. West, in Journ. Bot. 1903, p. 41, t. 446. f. 11; Monogr. Brit. Desm. i. 1904, p. 108, t. 10. f. 31.

Forma limnetica, W. & G. S. West. (Pl. **19.** figs. 11, 12.)
Forma apicibus cellularum valde truncatis, pyrenoidii in cellula tota 10.
Long. cell. 141–183 μ; lat. med. cell. 6 μ; lat. apic. 4·4–5 μ.
Hab. Loch Katrine (June 1909).

2. Spondylosium planum, (Wolle) W. & G. S. West. *Sphærozosma pulchrum*, Bail., var. *planum*, Wolle, Desm. U. S. 1884, p. 29, t. 4. ff. 3, 4. *Spondylosium pulchrum*, (Bail.) Arch., var. *planum*, W. & G. S. West, in Journ. Linn. Soc., Bot. xxxiii. 1898, p. 311; *ibid.* xxxv. 1903, p. 551; etc. *Spondylosium pulchrum*, Bachmann, in Archiv für Hydrobiol. u. Planktonkunde, iii. 1907, p. 30.

S. mediocre, filis non tortis, sine vagina mucosa; cellulæ circiter $1\frac{1}{6}$-plo latiores quam longæ, subquadratæ, angulis rotundatis, profunde constrictæ, sinu aperto et obtuso; semicellulæ transverse oblongæ, angulis rotundatis, apice recto; semicellulæ a vertice visæ oblongæ polis rotundatis, a latere visæ subcirculares; membrana glabra.

Long. cell. 11·5–19·5 μ; lat. 12–25 μ; lat. isthm. 5–11·5 μ; crass. 6–11 μ. (Pl. **19.** figs. 5–8.)

Hab. Fairly general in the plankton of all the British lake-areas.

We have placed this Desmid as a species because there is no possibility of confusing it with any other *Spondylosium*. It varies much in size, but retains its characters with great constancy. It has little, if any, relationship to *S. pulchrum*, (Bail.) Arch., differing in its much smaller size, in its plane and untwisted filaments, and in the flattened closely applied apices of the semicells. The semicells are of a different form from those of *S. pulchrum*,

and the cells are proportionately longer. Moreover, although this Desmid is common in the plankton of the British lakes, typical *S. pulchrum* does not exist in any part of the British Islands, or even in Europe.

3. ANKISTRODESMUS TORTILIS, W. & G. S. West. (Pl. **19.** figs. 9, 10.)

Cellulæ in coloniis parvis tortilibus subelongatis sublaxe aggregatæ, inter algas limneticas repertæ, singulæ minutæ, angustissimæ et acutissimæ, spiraliter contortæ, anfractæ $1–1\frac{1}{6}$; chromatophora pallide viridia sine pyrenoidiis.

Long. cell. 12–18 μ; lat. cell. 0·3–0·5 μ.

Hab. Ennerdale Water, Cumberland (May and Aug. 1909).

This minute species is characterised by the spirally twisted colonies, reminding one to some extent of a bit of yarn or a wisp of wool. The cells are very minute, with a pale green chloroplast, and are spirally twisted to the extent of one, or rather more than one, complete spiral. Each individual cell when isolated is very like a miniature representation of the solitary *A. falcatus* var. *spirilliformis*.

4. TETRASPORA LIMNETICA, W. & G. S. West. (Pl. **19.** fig. 13.)

Coloniæ parvæ, globosæ, subglobosæ vel indistincte lobatæ, libere natantes inter alias algas limneticas; cellulæ parvæ, globosæ, subconfertæ, indistincte 2–4-aggregatæ; pseudocilia distincta et breva.

Diam. colon. 124–220 μ; diam. cell. 4 μ.

Hab. Ennerdale Water, Cumberland (Aug. 1908).

This tiny limnetic species seems quite unlike any other, and can be compared only with *T. lacustris*, Lemm., from which it differs in its more rounded colonies, with much more numerous and smaller cells, and in its distinct pseudocilia.

5. APHANOCAPSA DELICATISSIMA, W. & G. S. West. (Pl. **19.** figs. 2, 3.)

Coloniæ parvæ, subellipsoideæ, libere natantes, tegumento firmo gelatinoso ochraceo et hyalino; cellula minutissima sphærica solitaria geminatave, subconferta; cytioplasma homogeneum et læte æruginosum.

Long. colon. 18–32 μ, lat. 14–23 μ; diam. cell. 0·5 μ.

Hab. Wastwater, Cumberland (Jan. 1910).

This minute species is characterised by its free-floating habit and the minuteness of its cells. It should be compared with *A. elachista*, W. & G. S. West, from which it differs in the cells being only one-third the size, and in the more crowded colony.

6. APHANOCAPSA ELACHISTA, W. & G. S. West, "Some Freshw. Alg. W. Indies," in Journ. Linn. Soc., Bot. xxx. 1894, p. 276, t. 15. ff. 9, 10.

Var. CONFERTA, W. & G. S. West. (Pl. **19**. fig. 1.)

Var. cellulis multo magis confertis.

Long. colon. 73 μ, lat. 52 μ; diam. cell. 1·6–2 μ.

Hab. Loch Katrine (March 1909).

This variety differs only in the more crowded disposition of the cells, which are of approximately the same density as in *A. delicatissima*.

7. APHANOTHECE NIDULANS, P. Richter, in Wittr. & Nordst. Alg. Exsic. 1884, no. 694.

Var. ENDOPHYTICA, W. & G. S. West. (Pl. **19**. fig. 14.)

Var. habitu endophytico intra colonias *Cœlosphærii Kützingiani*.

Long. cell. 2·5–4·5 μ; lat. cell. 0·8–1 μ.

Hab. Loch Lomond, Loch Katrine, Lough Neagh, etc., occurring as an endophyte within the colonies of *Cœlosphærium Kützingianum* wherever that Alga attains a large maximum.

The cells are of precisely the same form and size as many of the rod-shaped bacteria which frequent the gelatinous colonies of Algæ, but they are of a brilliant blue-green colour.

[We wish to emphasize the fact that the cells of this endophytic *Aphanothece* are not bacteria. This is the more necessary as rod-shaped bacteria occur commonly in and upon the colonies of *Cœlosphærium* and *Gomphosphæria*.

It is possible that the "Bazillus sp. I" described by Bachmann (Archiv für Hydrobiol. u. Planktonk. iii. 1907, p. 78, and p. 60, fig. iii 5) as occurring in the colonies of *Gomphosphæria Nägeliana* is identical with *Aphanothece nidulans* var. *endophytica*.

It would seem that the blue-green colour is the only outstanding feature which distinguishes species of *Aphanothece* from species of *Bacillus*, and as all the above specimens were brilliantly coloured we have referred them to *Aphanothece*.—W. & G. S. WEST, 28th April, 1912.]

EXPLANATION OF PLATE 19.

Fig. 1. *Aphanocapsa elachista*, W. & G. S. West, var. *conferta*, var. n. × 500.

2–3. *Aphanocapsa delicatissima*, sp. n. × 1000.

4. *Plectonema Boryanum*, Gomont. × 500.

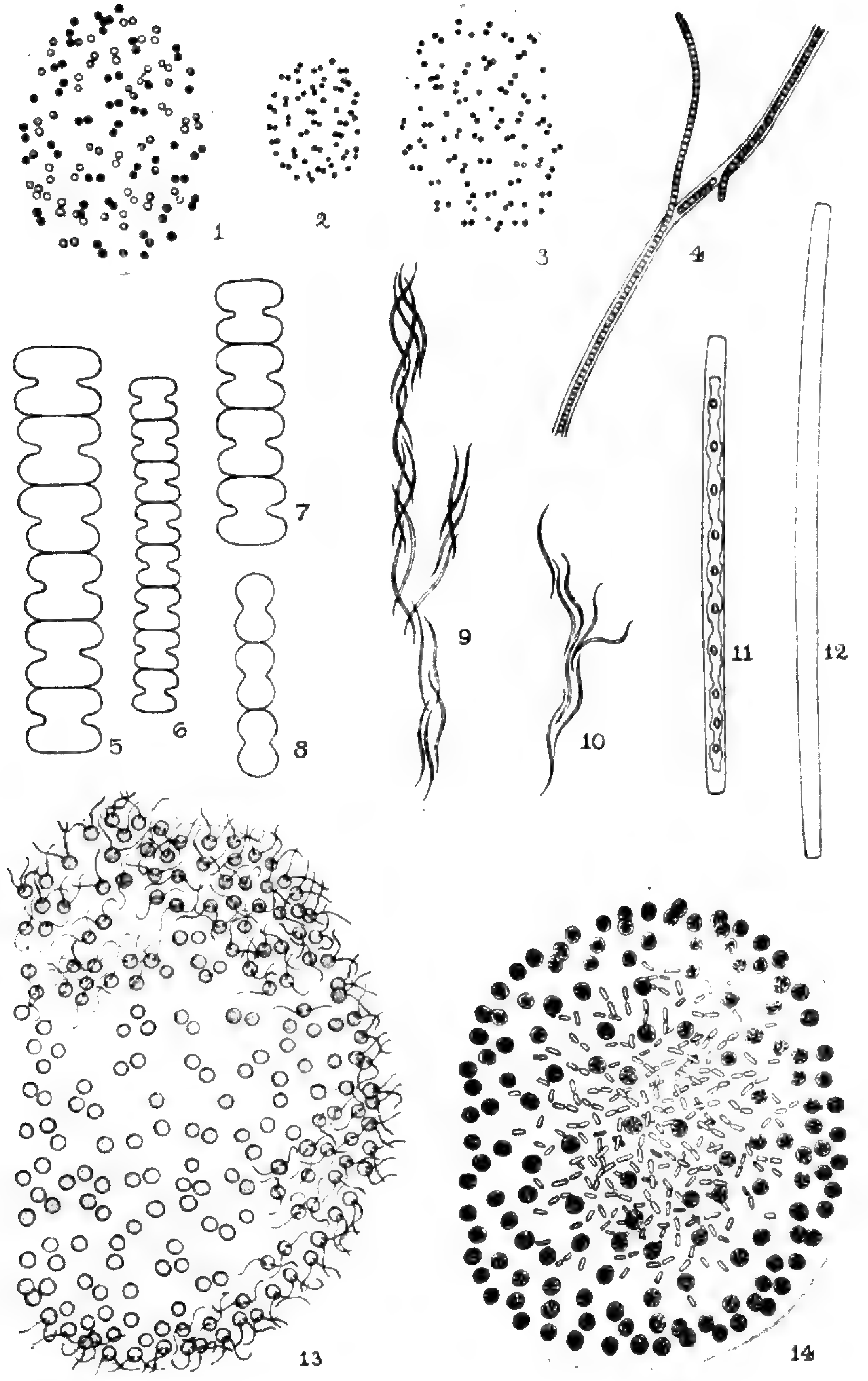
5–8. *Spondylosium planum*, (Wolle) nob. × 500.

9–10. *Ankistrodesmus tortilis*, sp. n. × 1000.

11–12. *Roya cambrica*, W. & G. S. West, forma *limnetica*. × 500.

13. *Tetraspora limnetica*, sp. n. × 500. The pseudocilia are not shown on all the cells.

14. *Aphanothece nidulans*, P. Richter, var. *endophytica*, var. n., within the colony of *Cœlosphærium Kützingianum*. × 500.



G. S. West, del. Grout. Intaglio et imp.

FRESH WATER PHYTOPLANKTON.

On some Mosses of New Zealand.

By Hugh Neville Dixon, M.A., F.L.S.

(Plates 20 & 21.)

[Read 7th December, 1911.]

The Mosses dealt with in the following pages were for the most part collected by Mr. James Murray, during the visit of the 'Nimrod,' on the British Antarctic Expedition, 1907–9, in two separate districts—(1) the moist subtropical bush on the Waitakarei Hills, 12 to 20 miles N.W. of Auckland, in the North I.; (2) a limited area of the Mt. Cook district in the South I., at heights ranging from 2500 to 5000 ft. A small but interesting gathering was made by Dr. Mackay at about 6000 ft. on the Nun's Veil Mt. in the latter district. I have also from time to time received collections of mosses from several collectors, made in different parts of New Zealand; and while it has not seemed desirable to give any extensive list of these collections here, I have included a certain number of them, either from their special interest as contributing additional knowledge to the bryology of New Zealand, or on account of light thrown by them on plants included in Mr. Murray's collections, either from the point of view of distribution or other causes.

The principal of these collections are as follows:—(*a*) A number of plants sent me from time to time collected by Mr. W. Gray in the neighbourhood of Mauriceville, Wairarapa, North I., some of them of the highest interest; (*b*) a collection made by Miss E. W. Blackwell near Karepo, Paparoa, Kaipara, to the north of Auckland, North I., in the spring of 1904; (*c*) several small gatherings by Mr. Arthur Perry, from the Okau River, near Levin, Horowenua, North I.; (*d*) a collection sent me by Mr. W. H. Burrell, made by Mr. Chas. J. Burgess near Hunterville, Rangitikei, North I., in 1905; (*e*) a further collection made by Mr. J. Meiklejohn, from Lake Wakatipu, South I., in 1904, and sent me by Rev. D. Lillie.

Although the total number of species comprised in Mr. Murray's collections and the others referred to does not bear a large proportion to the total moss-flora of New Zealand, their contribution to the bryology of the Islands is by no means unimportant. The moss-flora of New Zealand, like that of the higher plants, may be divided generally into three categories:—(1) The Malay-Australian, (2) the endemic, (3) the Antarctic-Fuegian. The mosses dealt with in this report make some, perhaps small, but not by any means insignificant, contribution to each of these categories. If, as I presume is a fair assumption, any species ascertained to be common to Tasmania (or

Australia) and New Zealand may be expected to have migrated from the former region to the latter, then the following list shows an addition of three species to the first category (exclusive of more or less cosmopolitan species here recorded for the first time), in plants hitherto known only from Tasmania or continental Australia. The five new species described form an addition, for the present at any rate, to the extensive endemic flora of the Islands; while in two cases at least—viz., the subgenus *Holodontium* (represented by the new species *Dicranum Mackayi*) and *Dicranoweisia antarctica*—we have a very interesting addition to the floral links between New Zealand and the Antarctic and Fuegian regions.

My thanks are due for assistance in working out the determinations of this list to Dr. Brotherus and Monsieur Cardot, and to the authorities of the British Museum and Kew Herbaria.

I have used the nomenclature and arrangement of Brotherus in the Musci (Engler & Prantl, Natürl. Pflanzenfamilien).

When the plant was found fruiting I have added "c.fr."; in all other cases no fruit was present.

SPHAGNACEÆ.

Sphagnum cymbifolium, Ehrh. Mt. Cook district (Murray, No. 83).

S. medium, Limpr. Mt. Cook district (Murray, No. 84). This species has not, I believe, been recorded for New Zealand, nor, so far as I am aware, has any record been published for Australasia.

ANDREÆACEÆ.

Andreæa petrophila, Ehrh. Nun's Veil Mt., 6000 ft. (Dr. Mackay, No. 132).

Andreæa (Chasmocalyx) Michellii, Broth. & Dixon, sp. nov. (Pl. **20**. figs. 1–5.)

Laxe cæspitosa, subaquatica (?), rufo-castanea vel superne rufo-olivacea; caulis gracilis, *parum divisus*, inferne remote supra densiuscule foliosus. Folia rufo-flavescentia, fragilia, *patentia, apice suberecta*, siccitate subcatenulate incurva, 1 mm. longa, e basi ovata vel oblonga *breviter late oblongo-lingulata, obtusa vel brevissime obtuse mucronata*, marginibus superioribus hic illic *anguste recurvis vel latius reflexis*, apice sæpius eroso. Costa valida, juxta basin dilatata, ad 100 μ, superne circa 50 μ lata, rufa, *percurrens*. Areolatio superior densa, pellucida, e cellulis parvis hexagono-rotundis incrassatis *lævibus* 4–7 μ latis instructa, cellulis juxta basin

marginem versus quadratis vel subquadratis, *parum majoribus, juxta costam tantum in paucis seriebus paullo elongatis breviter oblongis.* Flos masculus capituliformis, terminalis; bracteæ externæ foliis similes sed breviores, internæ breviter late ovatæ, subacutæ, vel suborbiculares, cymbiformes, enerves; antheridia clavata, breviter stipitata. Cetera ignota.

Hab. Mt. Cook district, South I., 2500–5000 ft.; leg. Michell (No. 66). Named after Dr. Michell, who was associated with Mr. Murray in collecting mosses on frequent occasions.

A distinct species, nearly allied to *A. australis*, F. Muell., from Australia, but differing from that in the simple, slender, laxly foliate stems and the leaves which are obtuse and broad at the apex, not in any way tapering or acute. In *A. australis* the lower leaves especially taper gradually to a subacute point, and are strongly incurved at the apex and often subcucullate. It is also very close to *A. clintoniensis*, R. Br. ter., of which no specimen appears to exist in Brown's herbarium, and which unfortunately I have not been able to see. The figures, however (Trans. N.Z. Inst. xxv. p. 276, 1892), show a very distinctly narrower nerve, and the lower leaves at least are acute, whilst, from the description, the plant is differently coloured (pale above, dark below), and the lower leaves are linear-lanceolate and acute; no reference is made to the cells. The uniformly short, broad and broadly-pointed leaves in our plant seem to distinguish it at once from all the hitherto described species of this group, though the two species referred to approach it closely in the form of the *upper* leaves.

Andreæa aquatilis, R. Br. ter., is a far larger, very robust plant, with longer leaves having acute points. *A. lanceolata*, R. Br. ter., is more robust, with acute leaves, narrower nerve, and very dense areolation.

DICRANACEÆ.

Ditrichum australe, Mitt. Mauriceville, Wairarapa, North I., 1909 (Gray, Nos. 62, 82), c.fr. The specimens of this species in Herb. Hook. at Kew show a great variation in the dentation of the subula, from sharply spinulose to entire or subentire.

D. affine (C. Muell.), Hampe. Mt. Cook district (Murray, No. 27), c.fr.

D. laxifolium (Hook. f. & Wils.), Broth. Mt. Cook district (Murray, No. 105), c.fr.

Ceratodon purpureus, Brid. Waitakarei Hills (Murray, No. 9), c.fr.

Dicranella Schreberi (Sw.), Schimp. Mauriceville, Wairarapa, North I., 1909 (Gray, No. 42).

D. clathrata, Hook. f. & Wils. Mauriceville, Wairarapa, North I., 1909 (Gray, No. 27); Lake Wakatipu, South I., 1904 (Meiklejohn, No. 12).

DICRANOWEISIA ANTARCTICA (C. Muell.), Par. Mt. Cook district (Murray, No. 126), c.fr. Det. Brotherus. This is one of the very interesting additions to the New Zealand flora. It is recorded by Paris from Marion I., Hermite I., and Campbell I., only, and is therefore of exclusively subantarctic distribution. Like several allied species it has a peculiar configuration of the leaves when dry, the upper part being strongly contorted while the lower half remains erect and unaltered.

LEUCOLOMA MENZIESII (Tayl.), var. RIGIDUM (Hook. f. & Wils.). Waitakarei Hills (Murray, No. 7). Paris, it may be noted, has omitted to give Tasmania in the distribution of this species.

L. BILLARDIERI (Schwaeg.), Broth. Waitakarei Hills (Murray, Nos. 18, 53).

L. SUBPUNGENS (Hampe), Broth. Mt. Cook district (Murray, No. 115), c.fr. Det. Brotherus. Recorded hitherto, I believe, only from Australia and Tasmania.

L. DICRANOIDES, Broth. (*Dicranum leucolomoides*, C. Muell.). Mt. Cook district (Murray, No. 117), c.fr. Det. Brotherus.

L. SETOSUM (Hook. f. & Wils.), Broth. Mt. Cook district (Murray, No. 129).

LEUCOLOMA sp. Mt. Cook district (Murray, No. 92). A plant in small quantity which I have not at present been able to determine.

L. ROBUSTUM (Hook. f. & Wils.), Broth. Lake Wakatipu, South I. (Meiklejohn, No. 4).

L. PUNGENTELLA (C. Muell.), Broth. Mauriceville, Wairarapa, North I., 1909 (Gray, No. 14). (Pl. 20. figs. 12–14.)

This was found by Mr. Gray growing in extensive dense patches 6 inches deep, in the bush under trees, and was observed by him for several years without showing any fruit. A capsule which appeared one year was found to belong to *L. Billardieri*, which grew associated with it and at first sight closely resembled it. It was evidently a close ally of *L. Billardieri*, with which Dr. Brotherus was inclined to associate it; but it presented certain characters of some weight, especially in the arrangement of the leaves, which are erecto-patent, not or very rarely and only slightly falcato-secund, and frequently, but not always, collected at the apex of the stem into a penicillate tuft or point, and also in the subtubulose entire or subentire subula, and the nerve, which is smooth or almost so at back. It appeared to be very near *D. Pungentella*, C. Muell., and through Herr L. Loeske's kindness I was enabled to compare it with C. Mueller's type in the Berlin Herbarium, and both Herr Loeske and myself felt no doubt of the identity of the two plants, allowing for a slight difference in habit. Herr Loeske at the same time

compared it with *Dicranum leucolomopsis*, C. Muell., n. sp., MS. in Herb. (Ins. Wairakai, New Zealand), and found it to agree even more exactly with that plant. Herr Loeske, however, considers—and I am entirely of the same opinion—that *D. leucolomopsis* cannot be separated from *D. Pungentella*:—"*D. Pungentella* ist vielleicht nur eine derbere xerophytischere Form von *leucolomopsis*." I am the more inclined to this view as Mr. Gray's plant shows two distinct forms, one taller, more slender and graceful, the other shorter, firmer, with more rigid, less graceful foliation, corresponding to the two plants of C. Mueller, but identical in structure, and both coming from the same station and I believe forming part of the same patch.

I should therefore propose the synonymy as follows :—

LEUCOLOMA PUNGENTELLA, Broth.

Syn. *Dicranum Pungentella*, C. Muell.

Dicranoloma Pungentella, Par. Index, ed. ii.

Dicranum leucolomopsis, C. Muell. MS. in Herb. et Gen. Musc. Frond. p. 290 (nom. nud.).

It has only been recorded hitherto from Tasmania, and as it has not been illustrated I have figured it on Pl. **20**. figs. 12–14.

Since the above was written I have received a few fruiting stems from Mr. Gray, gathered near Mauriceville in 1907. The sporophyte does not present any marked difference from that of *D. Billardieri*; the only distinction that I have been able to detect is the slightly longer seta, 3 cm to 3·5 and nearly 4 cm., while in *D. Billardieri* I have never seen it longer than 3 cm., while it is frequently much shorter.

DICRANUM (HOLODONTIUM) MACKAYI, Broth. & Dixon, sp. nov. (Pl. **20**. figs. 6–11.)

Dense *humillime* cæspitans, 1–2 cm. altum, sordido-viride, intus fuscum. Caules haud radiculosi, inter se arcte adhærentes, pluries divisi, tenelli. Folia sat conferta, *fortiter falcato-secunda vel hamata*, siccitate *parte superiore tortilia*, 3–4 mm. longa; e basi latiore (circa 0·5 mm. lata) sensim in subulam longam attenuatam hamatam profunde canaliculatam *subtubulosam integerrimam* angustata; costa angusta, 30–40 μ lata, percurrens. Areolatio e cellulis superioribus brevibus *quadratis vel rotundo-quadratis vel breviter oblongis* (lumine 7–8 μ lato), inferioribus sensim elongatis, prope basin ad 40 μ longis, linearibus, omnibus incrassatis, angulis rotundatis, instructa; cellulæ ad basin juxta costam perangustæ, alares plures latiores laxæ subquadratæ pellucidæ vel rufæ, *auriculas bene distinctas paullo inflatas magnas* efformantes. *Autoicum.* Flores ♀ aggregati, apicales; flos ♂ juxta suppositus, bracteis internis brevibus ovatis, antheridiis numerosis; perichætium 2 mm. longum, bracteis externis ovalibus, breviter obtuse cuspidatis patentibus, internis brevioribus late vaginantibus abrupte in subulam brevem attenuatis. Seta

perbrevis, 3 mm. longa, straminea, *sæpe flexuosa, curvata.* Theca minuta, deoperculata 0·65–0·70 mm. longa, late ovata, collo subnullo, *æqualis, lævis,* fusca, operculo oblique rostrato thecæ fere æquilongo. Exothecii cellulæ sat laxæ, late breviter rectangulares, parietibus tenuibus firmis, sub ore in 4–6 seriebus minores, transverse elongatæ, subincrassatæ. Calyptra cucullata, *lævis,* totam thecam obtegens. Spori 12–20 μ, læves. Peristomii dentes sub orificio inserti, breves, lanceolati, circa 120 μ longi, *integri,* incurvati, pulchre aurantiaci, sat dense lamellis tenuibus *haud prominentibus* præditi, *ambabus paginis grossiuscule papillosi nec striati.*

Hab. Nun's Veil Mt., Mt. Cook district, alt. 6000 ft.; leg. Dr. Mackay (No. 130).

This interesting little moss adds a fourth species to the subgenus *Holodontium*, a small group of *Dicranum* hitherto consisting of three species only, which in some respects form a connecting link between *Dicranoweisia* and *Dicranum.* The three remaining species were described by Mitten in the 'Musci Austro-Americani': one (*D. inerme*) from Andes Quitenses, leg. Jameson; the other two (*D. ramulosum*, Mitt., and *D. pumilum*, Mitt.) from Hermite I., Fuegia, leg. J. D. Hooker. *D. inerme* is a quite different plant, with a seta ¾ in. long, etc. I have not seen specimens of the other two plants, but they clearly differ from the New Zealand species: *D. ramulosum* in the shorter stems, leaves erecto-patent, striate, with different upper areolation; and *D. pumilum* in the longer seta, which Mitten describes as "*pedunculo elongato*," while that of *D. ramulosum*, which is 2 lines (=5 mm.) long, is described as "*breviusculo.*" The two species of the newly described genus *Verrucidens*, Card., placed by Brotherus under the tribe Seligeriæ, must also be compared: *V. turpis* differing notably in the papillose cells and prominent dorsal lamellæ of the lower part of the peristome teeth, and *V. immersus* in the immersed capsule. Our species would appear to show, in the peristome, a relationship between *Verrucidens* and *Holodontium.* In the habit and somewhat peculiar torsion of the upper part of the leaf when dry, while the lower half is erect and unaltered, it exhibits a resemblance to *Dicranoweisia antarctica* (C. Muell.). *Weisia Webbii*, R. Brown ter., has smaller, regularly quadrate, often roughish upper cells, smaller auricles, etc.

Campylopus torquatus, Mitt. Waitakarei Hills (Murray, No. 23), c.fr.

C. introflexus, Brid. Waitakarei Hills (Murray, No. 2).

C. appressifolius, Mitt. Mauriceville, Wairarapa, North I., Aug.–Sept. 1909 (Gray, Nos. 34, 61), c.fr.

Campylopus, spp. *C. clavato* affines.

The *Campylopi* of this group are very difficult to determine: partly because of the uncertainty which attaches to the value of slight differences in

the leaf form and structure in plants which are usually sterile, and even when in fruit do not exhibit any great diversity in form; partly because of the difficulty of ascertaining exactly what was intended by some of the earlier described species. One of the earliest of these was *Dicranum clavatum*, R. Br. (in Schwaegr.); and various plants have been so called and afterwards distinguished as new species, e. g., *C. appressifolius*, Mitt., and *C. insititius*, Hook. f. & Wils. Carl Müller, it may be mentioned, has also imported a considerable amount of unnecessary confusion, in his 'Genera Muscorum Frondosorum,' into a group already puzzling. In his introductory notes on *Campylopus* he debates the advantages of two lines of classification of the species, finally deciding on the method of first splitting up the genus into two broad groups—I. *Campylopodes piliferi*; II. *C. depiles*—remarking "da hierdurch schärfere Grenzen sich ergeben." He then proceeds to include in the C. piliferi *Camp. capillatus*, Hook. f. & Wils., which in Wilson's own Herbarium shows no trace whatever of hair-points either on the original or other specimens; and further, under the C. depiles, § *d*, C. capitiflori, he includes *C. clavatus*, R. Br. (which, whatever else may be uncertain, has hair-pointed leaves), and *C. insititius*, Hook. f. & Wils., also a piliferous species, while for some reason or other *C. appressifolius*, Mitt., finds no place here, nor, so far as I can discover, anywhere else.

Schwaegrichen's figure of R. Brown's *D. clavatum* shows a very widely-nerved leaf (the basal portion figured to a larger scale gives a different impression, but ought, perhaps, not to be relied on for this point), the nerve occupying at least two-thirds the width of the base. No alar cells are shown, but the enlarged figure 4 seems to indicate the possible presence of a small area of such cells before the removal of the leaf. A point, however, that appears to me of real importance is the character of the basal cells, which are carefully figured, and show a uniform reticulation of *shortly-rectangular, firm-walled* cells occupying the whole width of the lamina to the base. This would seem to exclude definitely from the scope of *C. clavatus* all those plants with a supra-alar region of hyaline cells forming towards the margin a kind of border of extremely narrow elongate thin-walled cells reaching obliquely upwards and clearly differentiated from the upper areolation, such as is frequent enough in *Campylopus* and is always a feature of, e. g., *C. introflexus*, Brid. It is present in a specimen in the Brit. Mus. Herbarium, which, with a wide nerve—above half the width of leaf at least,—has the clavate habit of Brown's species, and is labelled "*Dicranum clavatum*, R. Brown, in Schwaeg., King George's Sound, N.H., comm. Graham," in Herb. Shuttleworth, the name being written in Bruch's hand. The upper cells in this specimen are finely but distinctly muriculate, and with the basal areolation preclude, I think, the correctness of the naming. Two other specimens from Hampe's Herbarium, "Austral. felix ins. al.; Dr. F. Müller," and "Austral. Felix," are somewhat clavate in habit though

variable, have a distinctly narrower nerve, less than half the width of the leaf, and are quite without the supra-alar region of narrow marginal cells, the upper areolation gradually and uniformly enlarging downwards, often becoming rectangular but sometimes remaining in part oblique to the very base. They may quite probably represent R. Brown's plant, but without a closer comparison with the original specimen in Herb. Schwaegr. than I have been able to make I do not feel equal to pronouncing a decided opinion.

The Waitakarei plant differs at once, and I think crucially, from these in the supra-alar areolation as referred to above, while it differs from the figure (3) in Schwaegrichen in the distinctly narrower nerve, which is constantly less than half the width of the leaf ($\frac{1}{3}$ to $\frac{2}{5}$). There is generally a small patch of coloured basal cells, reaching to the nerve and slightly enlarged, but not forming distinct auricles. For these reasons I was inclined to regard it as a species probably distinct from the above-mentioned ones (Dr. Brotherus writes: "*C. clavato* affinis sed reticulatione basilari diversa. An n. sp.?"). But from the description and figures it appeared to be in all probability *C. insititius*, Hook. f. & Wils., a conclusion afterwards confirmed.

Campylopus insititius, Hook. f. & Wils. Waitakarei Hills (Murray, Nos. 8, 32).

I have compared this plant with *C. insititius* in Wilson's Herbarium, and find it to agree quite well with plants labelled "Tasmania, Oldfield," and "Tasmania, Stuart." It is new to New Zealand. Mitten appears to have doubted the distinctness of this species from *C. clavatus* (R. Br.), and there has indeed been considerable confusion concerning *C. clavatus* and its allies. This has often, no doubt, and certainly in some cases, arisen from misunderstanding as to what Brown's plant actually was, and it has seemed desirable to obtain information which would clear up some of the difficulties. I am indebted to the authorities of the Herb. Boissier, through the good offices of Dr. J. Briquet, for kindly sending me the original of Brown's plant from Duby's Herbarium. The specimens in that herbarium are two: one, of which the original label in Schwaegrichen's handwriting was "*Dicranum clavatum*, R. Br., Suppl. 3, 2; Van Diemen Land" ("scripsit Schwaegrichen qui ex Gaudichaud habuit" teste Dr. Colomb-Duplan); the other labelled "New Holland" (as I understand, collected by Sieber). These two plants undoubtedly represent two different species, and clearly the former (the Van Diemen's Land plant) is to be taken as the type of R. Brown's species. The Australian plant shows a distinct area of hyaline supra-basal cells, with a wide border of extremely thin-walled, elongate, hyaline cells running obliquely outwards and upwards (as in *C. introflexus*), with scarcely any distinct alar cells. The specimens are too fragmentary to give much idea of the habit, except that it is

different from that of the Van Diemen's Land specimen; the leaves are frequently shortly hair-pointed. I should have little doubt that this is the *C. insititius* of Hook. f. & W., from a study of original specimens as mentioned above; and it appears quite likely that it may have been a comparison of *this* plant with *C. insititius* that led Mitten to suggest the identity of that species with the *Dicranum clavatum* of R. Brown.

The type plant of Schwaegrichen's Herbarium is, however, quite a different thing. It is at once marked by its large, very distinct auricles, formed of suddenly enlarged dark brown alar cells. The presence of these auricles is at least suggested by Schwaegrichen's fig. 3, but they are not indicated in fig. 4, which represents the areolation of the lower part of the leaf on an enlarged scale. It is clear, however, that, intentionally or not, the supra-basal cells alone are figured, the leaf having been torn away, as frequently happens, leaving the alar cells behind. This has no doubt led to the supposition on the part of writers who only knew R. Brown's species from the description and from Schwaegrichen's figures, or from specimens wrongly distributed under that name, that *C. clavatus* was one of the species lacking distinct auricles. This is confirmed by the fact that in the 'Handbook of the New Zealand Flora' the descriptions of *C. appressifolius*, Mitt., and *C. clavatus* (R. Br.), which were to all intents and purposes drawn up by Mitten, omit all mention of auriclar cells for the latter, while they are attributed to *C. appressifolius*.

The nerve is about $\frac{2}{5}$ the width of the leaf above the auricles; I have not made a transverse section, but from a careful observation of the surfaces it is clear that the ventral cells are rather narrow, and the dorsal small and somewhat incrassate, and certainly more or less lamellose. A very few of the leaves show a short hair-point. The upper areolation of the expanded part of the lamina is obliquely rhomboidal and distinctly incrassate; passing lower in the leaf the cells become more rectangular, the bulk of them, however, remaining more or less short and incrassate—in fact Schwaegrichen's figure represents them fairly well, although I have not found them so regular as there depicted,—while the supra-basal margin shows a row or two of more elongate and probably less incrassate cells. This, however, is extremely narrow and indistinct: it is in some measure, at any rate, and possibly almost entirely due to erosion with age; and at the most it is entirely alien to the broad border of narrow, linear, hyaline cells which obtains in the species with a supra-basal area of thin-walled, hyaline tissue, such as *C. introflexus* and *C. insititius*.

The two stems shown on the sheet of the type specimen of *D. clavatum* are about 1–1½ inches high, with the leaves somewhat interruptedly comose, so that in the dry state the stem would no doubt under natural conditions take the clavate form suggested by the name. This is, however, the case

with other allied species, and while it may afford a distinguishing character in the case of *C. appressifolius*, it must not be looked upon as in any way specially characteristic of *C. clavatus*.

DICNEMOS CALYCINUS (Hook.), Schwaeg. Waitakarei Hills (Murray, No. 17), cum perichætio.

D. SEMICRYPTUS, C. Muell. Waitakarei Hills (Murray, No. 57), c.fr.

LEUCOBRYACEÆ.

LEUCOBRYUM CANDIDUM (Brid.), Jaeg. Waitakarei Hills (Murray, Nos. 28, 46).

L. TEYSMANNIANUM, Dozy & Molkenb. Geheeb in Rev. Bry. 1876, p. 3, in a short notice of some Australian mosses recently collected, gave, among other new species determined by C. Müller but not then published, *L. speirostichum*, C. Muell., adding in brackets "(selon *M. Hampe* c'est le *L. Teysmannianum*)." I have received from Rev. W. W. Watts a specimen named *L. speirostichum*, C. Muell., gathered near Ballina, N.S.W., and determined by Brotherus; and I have had several plants of the same species sent me from New Zealand, viz.: Kaipara, North I., 1904 (Blackwell, Nos. 7, 8, 9); Hunterville, Marton, North I., 1905 (Burgess, No. 12); Levin, North I., 1903 (Perry, No. 101). I should certainly be inclined to refer all these plants to the *L. Teysmannianum* of the 'Bryologia Javanica.'

FISSIDENTACEÆ.

FISSIDENS DEALBATUS, Hook. f. & Wils. Mauriceville, North I., 1909 (Gray, No. 33).

F. LIGULATUS, Hook. f. & Wils. Hunterville, Marton, North I. (Burgess, No. 7).

FISSIDENS sp. Waitakarei Hills (Murray, No. 52). Probably a new species of the Sect. Bryoideum, with leaves falcate and subundulate, very wide below, with narrow border reaching to apex: but the quantity is too small for accurate determination.

FISSIDENS (SEMILIMBIDIUM) ANISOPHYLLUS, Dixon, sp. nov. (Pl. **21**. figs. 42–45.)

Pusillus, dense gregarius seu cæspitosus, *pallide virens*. Caulis brevis, 2–3 mm. altus, simplex. *Folia caulis fertilis valde inæqualia*, 6–8-juga, *infima minuta, squamiformia, supra sensim majora, brevissime obtuse* late oblongo-ovata, remotiuscula; superiora *in comam conferta, multo longiora, lingulato-*

lanceolata acuta, suprema bina sæpe anguste lingulata, peracuta, 1–1·5 mm. longa, omnia siccitate incurva, vix crispata. Folia inferiora sæpius *omnino immarginata*, comalia in lamina vaginante sæpissime, sæpe quoque in laminis binis superioribus, *limbum variabilem angustissimum* exhibentia. Costa ad basin validiuscula, supra sensim angustata, pellucida, in foliis inferioribus sub apice soluta, in comalibus subpercurrens. Rete *pellucidum* distinctum, e cellulis superioribus irregulariter subhexagonis, 8–10 μ latis, sublævibus, nec chlorophyllosis, parietibus firmis subincrassatis, basilaribus paullo laxioribus *elongatis* instructum. Caules steriles inter fertiles intermixti, foliis remotiusculis, subæqualibus, brevibus subacutis, pellucidis, immarginatis. Foliorum omnium lamina dorsalis *infra sensim angustata, supra basin evanida.* Lamina vaginans, longitudine variabilis, sæpius medium folium circa attingens; in foliis comalibus *haud conduplicata, ventricose vaginans, vix equitans.* Dioica videtur; flores masculi haud visi. Seta terminalis, supra basin crassam subgeniculata, 2·5–3 mm. longa, theca (immatura) *erecta vel suberecta*, æqualis, operculo brevirostri. Calyptra parva, lævis. Peristomium sporique haud visi.

Hab. On a damp bank at side of road, Mauriceville, North I.; July 19, 1910 (Gray, No. 74), c.fr.

A rather interesting little plant, forming in some respects a link between the Sections *Semilimbidium* and *Heterocaulon.* It is especially noteworthy for the inequality of the leaves, which gradually increase in size upwards, becoming at the same time narrower and more acute, giving a somewhat fan-shaped outline to the frond. The widely-spreading, scarcely conduplicate vaginant laminæ of the upper leaves and the variable border (which on the vaginant lamina is occasionally intramarginal) are other characters.

It is perhaps most nearly allied to *F. vittatus*, Wils., but the areolation in that is short to base, the border is quite different (*usually* intramarginal on the vaginant lamina), the upper cells much more obscure, and the nerve and border much more pellucid. *F. brevifolius*, Hook. f. & Wils., has not the peculiar foliation of our plant. *F. semilimbatus*, Hampe & C. Muell., has the leaves subequal, and all the leaves acute and narrower, and a subexcurrent nerve. *F. ramiger*, C. Muell. & Beckett, is also near it, but has fewer leaves, with the superior lamina of the upper pair forming a peculiar, narrowly ligulate point.

The vaginant lamina in the lower leaves of our plant frequently occupies the greater part of the leaf, and is often rather amplexicaul than vaginant, but the apex has not the peculiar form characteristic of the best marked species of the Section *Heterocaulon.*

POTTIACEÆ.

Weisia flavipes, Hook. f. & Wils. Mauriceville, North I., 1910 (Gray, Nos. 73, 75, 77), c.fr.

TRICHOSTOMUM MUTABILE, Bruch. Waitakarei Hills (Murray, No. 50), c.fr. immaturo et setis.

TRICHOSTOMUM GROSSIRETE, Broth. & Dixon, sp. nov. (Pl. 20. figs. 15–18.)

Cæspitans, lutescens, inferne fuscum, *sat robustum,* 2 cm. altum. Caulis parce divisus, circa 0·4 mm. crassus, in sectione transversa rete laxum tenue, fasciculum centralem sat magnum, corticem in 1–2 seriebus cellularum minorum valde incrassatarum rufarum instructum exhibens. Folia valde conferta, *rigida, fragillima,* erecto-patentia, sicca *rigide torquata,* vix nitida, 4–4·5 *mm. longa,* 0·8 mm. lata, e basi latiore suberecta lingulato-lanceolata, subobtusa, *cuspidata,* marginibus *recurvis,* integerrimis, e papillis minute crenulatis; costa valida, juxta basin 70–100 μ lata, dorso valde prominens, lævis, apice *in cuspidem longum validum strictum* excurrens, in sectione transversa plano-convexa, duces 4–5 magnos centrales, cellulas reliquas fere homogeneas parvas substereideas exhibens. Areolatio superior subpellucida, e cellulis *magnis,* 12–18 μ *latis,* hexagono-rotundis, incrassatis, papillis sæpe geminatis dense coronatis, instructa; cellulis basin versus sensim crescentibus, basilaribus *per-elongatis linearibus,* lævibus, parietibus tenuibus, flavescentibus pellucidis, juxta marginem brevioribus rectangularibus. Cetera ignota.

Hab. On earth, Waitakarei Hills (Murray, No. 48).

Well characterized by the size of the cells and the rigid, fragile, stoutly cuspidate leaves. The only nearly allied Australasian species is *Tr. sciophilum,* C. Muell., which is a much smaller, more delicate plant, with small leaves and smaller cells.

TORTELLA KNIGHTII (Mitt.), Broth. Kaipara (Blackwell, No. 46); Mauriceville (Gray, No. 19).

TRIGUETRELLA PAPILLATA (Hook. f. & Wils.), Broth. Waitakarei Hills (Murray, No. 20). The fruit of this moss is very rare, but immature fruit was sent me recently from Opaki, Wairarapa, North I., gathered in Aug. 1910, by Mr. Gray.

BARBULA AUSTRALASIÆ (Hook. & Grev.), Brid. Mauriceville, Wairarapa, North I., 1910 (Gray, Nos. 41, 71), c.fr. The South American plant which has figured under the same name is very near, but not identical; the cells are laxer, less incrassate, more quadrate, the capsule narrower, and the lid shorter. The true name for that plant appears to be *B. Poeppigiana,* C. Muell. The New Zealand plant however itself shows some variation in the length and form of the capsule.

B. TORQUATA, Tayl. Mauriceville, Wairarapa, North I., 1910 (Gray, No. 72).

BARBULA CALYCINA, Schwaeg. Waitakarei Hills (Murray, No. 43).

CALYPTOPOGON MNIOIDES (Schwaeg.), Broth. Mt. Cook district (Murray, No. 95). Mr. Gray has sent me a few capsules of this rare fruiter, gathered on willows at Mauriceville in Sept. 1908.

TORTULA RUBRA, Mitt. Mt. Cook district (Murray, No. 75). A few sterile stems. The 'Handbook of the New Zealand Flora' does not mention the striking papillose basal cells of this species; the cells are elongate and linear, with large rounded papillæ along the lumen, which are in the lowest cells mostly set in a single row, with occasionally two side by side. (Pl. **20**. fig. 19.)

T. PRINCEPS, De Not. Mt. Cook district (Murray, No. 110).

GRIMMIACEÆ.

GRIMMIA TRICHOPHYLLA, Grev. Waitakarei Hills (Murray, No. 42).

G. PULVINATA, var. OBTUSA, Bruch & Schimp. (var. *africana*, Hook. f. & W.). Waitakarei Hills (Murray, No. 41), c.fr.

RHACOMITRIUM CRISPULUM, Hook. f. & Wils. Mt. Cook district (Murray, No. 120), c.fr.

R. SYMPHYODON, Mitt. Waitakarei Hills (Murray, No. 54). Mt. Cook district (Murray, No. 112); id. (Murray, No. 114), c.fr., and with ♂ flowers, which are very numerous on the stems, on short lateral branches, giving the plant a very characteristically Rhacomitrioid appearance, quite different from that of the fruiting plant. Boulders, Opaki, Wairarapa, North I., 1910 (Gray, No. 87).

R. PTYCHOPHYLLUM, Mitt. Mt. Cook district (Murray, Nos. 68, 76). No. 76 has more of the Rhacomitrioid branching than No. 68, which has the branches regularly fastigiate, and julaceous with the crowded appressed leaves.

R. LANUGINOSUM, var. PRUINOSUM, Hook. f. & Wils. (*R. pruinosum*, C. Muell.). Mt. Cook district (Murray, No. 67).

ORTHOTRICHACEÆ.

ZYGODON INTERMEDIUS, Bruch & Schimp. Waitakarei Hills (Murray, No. 44), c.fr. Mt. Cook district (Murray, No. 125). I have received a plant from Mr. Gray, gathered at Mauriceville (No. 52), with a paler, thinner walled, less deeply plicate capsule. Specimens in the Kew Herbarium show, however, a considerable degree of variation in these respects, one especially

in Hooker's Herbarium (leg. Mueller, 1855, Victoria, No. 41) being almost identical with Mr. Gray's plant. Two unnamed specimens in Mitten's Herbarium, "New Zealand, F. Reader, 5 and 6," also belong to this species.

Zygodon Menziesii (Schwaeg.), Walk. Arn. Mauriceville, Wairarapa, North I. (Gray, No. 65), c.fr.

Z. neglectus, C. Muell. (*Z. obtusifolius*, Hook. f. Handb. N. Z. Fl. p. 434, *non* Hooker). Mauriceville, Wairarapa, North I. (Gray, Nos. 47, 50), c.fr.

Macromitrium ligulare, Mitt. Mauriceville, Wairarapa, North I. (Gray, No. 51), c.fr.

M. eucalyptorum, Hampe & C. Muell. Mauriceville, Wairarapa, North I. (Gray, No. 5), c.fr.

? M. flaccidisetum, C. Muell. Waitakarei Hills (Murray, No. 60), c.fr. A somewhat doubtful determination; the material is poor.

Macromitrium (Goniostoma) rigescens, Broth. & Dixon, sp. nov. (Pl. **20**. figs. 20–24.)

Dense late prorepens, rufo-flavescens, sat robusta, ramis *densis*, 1–1·5 c.m. longis, *dense fastigiate ramulosis*, strictis. Folia sat conferta, erecto-patentia, *siccitate arcte adpressa, parum curvata*, apice incurvo-torquato, 2–2·5 mm. longa, e basi ovata breviter late lanceolata, brevissime acutata, subacuta vel subobtusa mucronata, pluries plicata, prope basin uno margine late altero sæpius angustius recurva, marginibus superioribus hic illic anguste recurvis. Costa profunde canaliculata, percurrens, dorso lævis. Cellulæ superiores in seriebus longitudinalibus regularibus dispositæ, *sat pellucidæ, parum incrassatæ, rotundæ*, 12–14 μ *latæ*, basilares circa *ad quartam partem* folii elongatæ, sat pellucidæ, angustissime lineares, incrassatæ; summa quæque superiorum et plures e basilaribus *papilla conica alta pellucida* præditæ; marginibus quoque, præcipue ad basin, *papillis longis interdum geminatis alte cristatis*. Vaginula pilosa. Seta *perbrevis*, ad 3·5 mm. longa, lævis. Theca elliptica, ad basin sensim angustata, ore constricto, leviter plicato, *gymnostoma*. Exothecii rete orificium versus parvum, isodiametricum, incrassatum, infra sensim elongatum laxiusque. Calyptra parce pilosa. Spori 20–25 μ, minute papillosi.

Hab. Mt. Cook district (Murray, No. 69), c.fr.

This species belongs to a small group confined to New Zealand, and represented by three species, *M. submucronifolium*, Hampe & C. Muell., *M. grossirete*, C. Muell., and *M. papillifolium*, C. Muell. The last two species have short subglobular branches with crisped leaves, while *M. submucronifolium* is a very much smaller plant with quite a different habit and

leaves curled when dry. From other plants of more similar appearance it is distinguished by its gymnostomous capsule and larger papillose cells.

MACROMITRIUM RETUSUM, Hook. f. & Wils. Waitakarei Hills (Murray, No. 26).

M. CADUCIPILUM, Lindb. Waitakarei Hills (Murray, No. 26 *a*).

A doubt has often presented itself to my mind as to whether *Macromitrium caducipilum*, Lindb., and *M. retusum*, Hook. f. & Wils., were distinct species. They were described independently, and there is no reference to the former in the 'Handbook' description of *M. retusum*. While that species was certainly not known to Lindberg (although his species was not described until several years later than the original description of *M. retusum*), this is clear from his description of the remarkable deciduous nerve in his species, "structura nervi ab omnibus speciebus generis distinctissima et curiosissima," which structure is, however, exactly identical in the plant of Hook. f. & Wils. Nor is there anything in the descriptions of the two mosses to distinguish one from the other. Among Mr. Murray's gatherings, however, were some of a *Macromitrium* which I at once referred to *M. retusum*; but on closer examination at a later time I detected the presence of two distinct plants, noticeably differing in the enrolling of the leaves when dry. After careful examination I was able to find other differences; and on comparison with original specimens, on the one hand of *M. retusum* (Colenso, 1911, in herb. Wils.), and on the other of *M. caducipilum* from an original specimen from New Zealand leg. Ralfs, kindly lent me by Dr. Brotherus, I was able to assure myself of the identity of Mr. Murray's two plants with the two species in question. As they have not previously been compared, it will be well to indicate shortly the distinguishing characters. The peculiar structure of the nerve is described briefly by Lindberg in his diagnosis of the species, and at length by Correns, 'Vermehrung der Laubmoose,' p. 121.

The leaves in *M. retusum* are more spreading than in *M. caducipilum*: in the latter they are straight and erecto-patent, with no marked differentiation of base and lamina; in the former the base is erecto-patent, and the upper part is distinctly bent back above the base so as to form a separate, more patent lamina; this latter part in *M. retusum* is of a very marked oblong-lingulate form, with the margins entirely straight and parallel up to the obtuse apex, while in Lindberg's plant it is shorter and usually shows some narrowing towards the apex. The nerve in *M. retusum* is stouter, about 45–50 μ in width near the base, that of *M. caducipilum* measuring (in the few leaves which I have been able to examine) 35–45 μ; and the upper cells in *M. caducipilum* are perhaps a shade larger (5–8 μ wide) than in *M. retusum* (5–7 μ wide). The position of the leaves in the dry state affords the best test; the leaves in *M. caducipilum* are *spirally twisted round the stem*, with

varying degrees of regularity, and curiously not by any means always in the same direction even on the branches of the same plant, but always showing the character with more or less marked distinctness. Apart from this spiral twisting round the stem, the leaves are as a rule but little incurved or twisted on their own axis, though where the spiral arrangement is not well marked they are often more flexuose and occasionally have the points considerably incurved.

In *Macromitrium retusum*, on the other hand, there is no spiral enrolment of the leaves upon the stem, but they are more or less twisted upon their own axis, and always *with the apex strongly incurved or involute*. This sometimes, when the leaves are not uniformly twisted on themselves, gives a somewhat irregular appearance to the stem, as the incurved points turn in various directions; but when, as happened to be the case in Mr. Murray's plant, the lower part of the leaves was scarcely twisted, the enrolled apices are all directed inwards, giving a terete outline to the stem, which in that case shows a prettily spiral arrangement, due, however, entirely to the spiral disposition of the leaves on the stem, not in any sense to a spiral twisting. In both cases, as well as in *M. caducipilum*, the stem or branch is crowned by the penicillate tuft of erect nerve-aristas, which persist on the youngest leaves, while they are almost entirely lost on the lower ones, and by which these species are at once known from their allies.

It is a curious coincidence that two New Zealand species showing the same remarkable structure of nerve and in other ways closely allied, and yet really distinct, should have been independently described and so nearly at the same time. Mr. Murray's two plants, it should be noted, had been placed together on account of their similarity, but were not necessarily collected at the same time.

BRYACEÆ.

Mniobryum tasmanicum, Broth. Mt. Cook district (Murray, No. 118): det. Broth. In very small quantity, but a beautiful little form of this moss, the whole plant being of a bright rosy red. It is new to New Zealand, having, I believe, only been recorded hitherto from its original station on Mt. Wellington, Tasmania, where it was collected by Weymouth.

Bryum austro-pallescens, Broth. Mt. Cook district (Murray, No. 102), c.fr.

B. chrysoneuron, C. Muell. Waitakarei Hills (Murray, No. 45), c.fr.

B. lævigatum, Hook. f. & Wils. Mauriceville, Wairarapa, North I. (Gray, No. 18), c.fr.

B. blandum, Hook. f. & Wils. Waitakarei Hills (Murray, No. 36).

Bryum incurvifolium, C. Muell. Mt. Cook district (Murray, No. 88). A tall plant, some 3 inches high, the stems falling apart readily, and evidently growing deeply embedded in sand. I have compared it with a specimen of C. Müller's original plant (Kaipara, leg. Mossman) at Kew, with which it entirely agrees except in the taller habit, and in having the apex of the leaf sometimes obscurely denticulate, while in the original it is usually quite entire, rarely faintly sinuate. C. Müller describes the nerve in his plant as excurrent, but I have found it as a rule at the most percurrent, only rarely barely excurrent as a short and indistinct mucro. The name is not very appropriate, for the leaves are not incurved in any marked degree as compared with others of the group.

B. Huttonii, R. Br. ter. Mt. Cook district (Murray, No. 80). A tall robust paludal moss, with large, obtuse, subcucullate leaves, allied to *B. lævigatum*. It agrees with a specimen of *B. Huttonii* in the herbarium of the late R. Brown of Christchurch ; but as to the validity of the species I am not at present able to speak. It appears, however, to be a good species, and well distinct from *B. lævigatum* on the one hand, and *B. eximium*, Mitt., on the other.

B. leptothecium, Tayl. Waitakarei Hills (Murray, No. 11), c.fr. Mt. Cook district (Murray, No. 63), c.fr. : det. Brotherus. A slender form with the comal leaves more erect and imbricated when moist than usual, as in *B. campylothecium*, but with the strong border that is wanting in that species. Mt. Cook district (Murray, Nos. 89, 119), c.fr. : det. Brotherus. Both these numbers represent a form with an excessively wide border, especially towards the apex, where the two borders often become confluent, and form a colourless, scarious tip to the leaf ; but this character varies a good deal even on the same plant, and they probably belong to the somewhat polymorphic *B. leptothecium*.

LEPTOSTOMACEÆ.

Leptostomum macrocarpum, R. Br. Waitakarei Hills (Murray, No. 49). Mt. Cook district (Murray, No. 96), c.fr.

L. inclinans, R. Br. Mt. Cook district (Murray, No. 104).

MNIACEÆ.

Mnium rostratum, Schrad. Mt. Cook district (Murray, No. 99).

RHIZOGONIACEÆ.

Hymenodon piliferus, Hook. f. & Wils. Waitakarei Hills (Murray, No. 12), c.fr.

AULACOMNIACEÆ.

Leptotheca gaudichaudii, Schwaegr. Mt. Cook district (Murray, No. 98). The apex of the branches occasionally bears a densely agglomerated mass of broad filaments, forming a dark brown capitulum, each body consisting of a stout, brown, unbranched, closely articulated cylindrical thread, the terminal joint being sometimes hyaline.

Aulacomnium palustre, Schwaeg., forma gracilis. Mt. Cook district (Murray, No. 87). A form very near var. *laxifolium*, Kindb., but perhaps best kept separate. *A. palustre* is recorded from Tasmania, but has not hitherto been found in New Zealand.

BARTRAMIACEÆ.

Bartramia Halleriana, Hedw. Mt. Cook district (Murray, No. 77), c.fr. Lake Wakatipu, South I. (Meiklejohn, No. 13), c.fr.

B. patens, Brid. Mt. Cook district (Murray, No. 91), c.fr. Mauriceville, Wairarapa, North I. (Gray, No. 85); a very small form.

B. papillata, Hook. f. & Wils. Mt. Cook district (Murray, No. 116), c.fr.

Philonotis australis (Mitt.), Par. Mauriceville, Wairarapa, North I. (Gray, No. 23).

P. scabrifolia (Hook. f. & Wils.), Broth. (*Bartramia appressa*, Hook. f. & Wils.; and *B. remotifolia*, Hook. f. & Wils.). Waitakarei Hills (Murray, No. 56), ♂. Mt. Cook district (No. 72, st.; No. 101, c.fr.).

Breutelia affinis (Hook.), Mitt. Waitakarei Hills (Murray, No. 5).

B. comosa, Mitt. Waitakarei Hills (Murray, No. 27). Mt. Cook district (Murray, No. 86).

CALOMNIACEÆ.

Calomnion lætum, Hook. f. & Wils. Mauriceville, Wairarapa, North I. (Gray, No. 21).

POLYTRICHACEÆ.

Pogonatum tortile (Sw.), P. Beauv. Kaipara, near Auckland, North I. (Blackwell, No. 19), c.fr. I cannot separate this from Swartz's species. A very characteristic feature in *P. tortile* is the narrow raised lines which run longitudinally along the capsule, and which may be called ribs, but are not elevated enough to render the capsule angled. They are normally six in number, but are not always all developed. The Kaipara plant above noted shows these distinctly. *P. australasicum*, Hampe & C. Muell., is described as "theca . . . ubique *lævis*"; if this is correct, Miss Blackwell's plant cannot

be referred there; and in any case, apart from this character, the other characters given for *P. australasicum* would not appear by themselves to justify its separation from *P. tortile*. The specimens in Hampe's Herbarium show capsules almost or quite smooth; but there is a suspicion of a rib about some, and I should doubt whether it is really distinct from *P. tortile* in this character if more material were studied. But without further knowledge I do not feel able to give an opinion as to whether there is more than one New Zealand species of this group.

HEDWIGIACEÆ.

Rhacocarpus australis (Hampe), Par. Mt. Cook district (Murray, No. 63).

CYRTOPODACEÆ.

Cyrtopus setosus (Hedw.), Hook. f. & Wils. Waitakarei Hills (Murray, Nos. 16, st., 35, c.fr.).

ECHINODIACEÆ.

Echinodium hispidum (Hook. f. & Wils.), Jaeg. Waitakarei Hills (Murray, No. 40).

PTYCHOMNIACEÆ.

Glyptothecium sciuroides (Hook.), Hampe. Mt. Cook district (Murray, No. 121).

Cladomnion ericoides (Hook.), Hook. f. & Wils. Waitakarei Hills (Murray, No. 37), c.fr.

Ptychomnion aciculare (Brid.), Mitt. Waitakarei Hills (Murray, No. 4). A very small, dense form, which is quite different in habit from the typical plant; but I can find no structural differences. It is certainly not *P. densifolium* (Brid.), nor *P. subaciculare*, Besch.

Tetraphidopsis novæ-seelandiæ, Broth. & Dixon, nov. genus Ptychomniacearum. (Pl. **21**. figs. 25–41.)

Corticola, pumila, dense gregaria vel subcæspitosa, *saturate viridis*, subnitida; caulis subrigidus, hic illic parce ramosus, circa 1 cm. altus, rufofuscescens, ad 180 μ latus, in sectione transversa rete internum laxum, *fasciculum centralem nullum*, corticem rufescentem e 2–3 seriebus cellularum parvarum, valde incrassatarum instructum exhibens. Folia patentia, sicca suberecta vel erecto-patentia, contracta, *parum torquata, stricta*; remotiuscula, quinquefaria, e basi angustiore angustissime decurrente, *triangulari-lanceolata* pellucida; inferiora breviter, media *tenuiter acuminata*, majora (ad 2 mm. longa); superiora (in caulibus gemmiparis) *breviora, sensim magis magisque obtusa, suprema parva, late ovata rotundato-obtusa*, erecta, subappressa; omnia

integerrima, ad basin concavo-carinatam *uno margine late fortiter reflexo*, superne marginibus hic illic angustissime reflexis; costa *perbreris, obscura, tertiam partem vel minus* folii attingens, pro more lata, tenuis, in sectione transversa *angustissime plano-convexa, e cellulis homogeneis angustissimis* instructa. Areolatio valde regulariter *hexagono-rhomboidea, prosenchymatosa*, 40–50 μ longa, 8–10 μ lata, saturate chlorophyllosa, parietibus tenuibus, apice paullo brevior, cellulæ basilares in medio folio elongatæ, angustiores, ad angulos numerosæ irregulariter sub-rectangulares, parietibus paullo crassioribus, sæpe rufescentibus.

Caules sæpius *gemmipari, capitulum dense agglomeratum ei Aulacomnii androgyni* similem nec autem stipitatum, folia suprema vix superantem gerentes; gemmæ numerosissimæ, breviter fusiformæ vel anguste clavatæ, articulatæ, e cellulis 4–6 chlorophyllosis, in seriebus singulis dispositis instructæ. Gemmæ sæpe quoque nonnullæ in foliorum superiorum axillis inveniuntur.

Dioica. (Flos masculus haud visus.) Perichætia sparsa, ad ramos lateralia, haud radicantia, 2 mm. longa; bracteæ externæ foliis caulinis subsimiles, internæ 2–3 magnæ, *convolutæ, subobtusæ nec acuminatæ*; seta *brevis*, 2–2·5 mm. longa, rufa; theca *parva*, vix 2 mm. longa, erecta, symmetrica, anguste elliptica, ætate viridis, vel fusco-viridis, *profunde 8-plicata*, operculo conico-rostellato, pallido. Calyptra haud visa. Annulus male evolutus, persistens. Exothecii cellulæ subquadratæ angulis rotundatis vel irregulares, in seriebus longitudinalibus sæpius dispositis, parietibus firmis, paullo incrassatis.

Peristomium duplex, *pallidum*, parvum, sub orificio paullo insertum; dentes externi circa 0·2 mm. longi, *lineari-lanceolati*, pallidi, sicci crispati, tenues, sat remote trabeculati (lamellis haud prominentibus), ad lineam mediam pertenuem aliquando pertusi, ad infimam basin tantum (infra orificium) tenuissime transverse striolati, supra *læves*; endostomium *sine membrana basilari conspicua e processibus tenuibus filiformibus* articulatis, raro appendiculatis, dentes haud æquantibus, instructum. Spori ad 32 μ, minute punctulati.

Hab. On the bark of trees, supple jack, &c., in several localities in the neighbourhood of Mauriceville, Wairarapa, North I., 1909–1910; c. fr., summer, 1910–1911; leg. W. Gray (Nos. 81, 54, &c.).

A very interesting and remarkable little plant. Until the fruit was detected—a few capsules only—by Mr. Gray, it was even doubtful whether its place was in the Acrocarpous or Pleurocarpous mosses; there is no distinct differentiation of a primary and secondary stem, the slightly branched stem growing more or less erect from the bark of the host plant. The capsules, however, showed by their deep plication and the peristome, with the pleurocarpus inflorescence, that it must take its place among the Ptychomniaceæ, and near *Glyptothecium* (*G. gracile*, Hampe, may be compared). The

gemmiparous stems show at first sight a resemblance to *Aulacomnium*, but the structure of the gemmæ is quite different, and the capitulum is enclosed in bracts resembling those of *Tetraphis* but smaller. Gemmiparous branches are not wanting on the fertile plant.

It occurs among other mosses and Hepaticæ on the stems of trees in shady positions, associated especially with a species of *Orthotrichum* and *Cryphæa acuminata*.

NECKERACEÆ.

Weymouthia mollis (Hedw.), Broth. Waitakarei Hills (Murray, No. 47). The ordinary form. Another gathering (No. 24), represented by a single tuft, is a very different plant, pale green but not whitish, more robust and more rigid, with less elongate, more closely branched stems. It is midway in size between *W. mollis* and *W. Billardieri,* with the habit of the latter and the leaves of the former. It may possibly be a new species, but in the absence of fruit and the small quantity of material it is better perhaps to leave it in abeyance at present. The only specimen I have seen at all approaching it is a specimen in Herb. Mus. Brit.: "N. Z., Dr. Stanger, comm. Dr. Balfour, 1842," in herb. G. J. Lyon, which has the greener colour and more rigid habit, but is smaller, not indeed very much more robust than the normal plant.

W. Billardieri (Hampe), Broth. Waitakarei Hills (Murray, No. 39), c.fr. Mt. Cook district (Murray, No. 123). I have also had fine specimens in fruit sent me by Mr. Ar. Perry from Inglewood, Taranaki, North I., gathered in Jan. 1902.

Papillaria filipendula (Hook. f. & Wils.), Jaeg. Waitakarei Hills (Murray, No. 55). I find the greatest difficulty in separating *P. filipendula* from *P. flexicaulis* (Tayl.), Jaeg. According to Brotherus, *P. filipendula* should have the leaves only slightly auricled and unbordered, and *P. flexicaulis,* on the other hand, wide auricles and a narrow colourless border reaching some way up the leaves; further, according to Bastow, the auricles of *P. filipendula* are serrulate, and those of *P. flexicaulis* subentire. I find, however, in No. 55 the auricles toothed, but the pale border present, and the same is the case with a plant sent me by Miss E. W. Blackwell from Kaipara, in 1904 (No. 30); so that Bastow's distinction appears to be valueless. Murray's No. 55 has the leaves entire, scarcely auricled, and without border; it should therefore, as well as the Kaipara plant, according to Brotherus, belong to *P. filipendula*.

Leptodon Smithii, Brid. Mt. Cook district (Murray, No. 64). A robust plant, which apparently does not coil up when dry to the same extent as the European plant does.

Orthorrhynchium elegans (Hook. f. & Wils.), Broth. Kaipara, near Auckland (Blackwell, No. 31).

Homalia auriculata, Hook. f. & Wils. Waitakarei Hills (Murray, No. 31); Kaipara, near Auckland, North I. (Blackwell, No. 36). There appears frequently to be some confusion in collections between this and *H. pulchella*, Hook. f. & Wils. In Hampe's Herbarium the specimens labelled *H. pulchella* clearly belong to *H. auriculata*. Wilson's own specimens show *H. pulchela* to be the smaller plant, with leaves distinctly denticulate, while *H. auriculata* is quite distinct, larger, glossy, with broader fronds and the leaves subentire.

H. falcifolia, Hook. f. & Wils. Kaipara, near Auckland, North I. (Blackwell, No. 35).

Thamnium pandum (Hook. f. & Wils.), Jaeg. Mt. Cook district (Murray, Nos. 94, 111).

Thamnium latifolium (Dozy & Molkenb.), Kindb. (*Th. australe*, Lindb. MS.). Waitakarei Hills (Murray, No. 33). A rigid, dendroid plant, with short, broad, very complanate frond, and close, regular, tripinnate branching, the branches scarcely at all flagelliform. In habit it has nothing in common with the *Porotrichum latifolium* of the 'Bryologia Javanica,' as indicated by the figure, or as represented by the Sumatran plant (*e.g.* Sumatra, leg. Beccari, in Herb. Kew.). But the specimen in Knight's Herbarium, on which Lindberg's MS. name was founded, and on which Kindberg established the identity with the East Indian species, is just intermediate between the two, though much more nearly according with the original species; while, on the other hand, Murray's plant, so different in habit, agrees exactly with Knight's in the form and structure of the leaves. I am therefore induced, though with some hesitation, to refer Murray's No. 33 to *Th. latifolium*.

There has been some confusion, perhaps partly caused by this plant, as to what is *Thamnium pumilum* (Hook. f. & Wils.). An Australian species, now determined as *Th. eflagellare*, Ångstr., has been distributed as *Th. pumilum*, Hook. f. & Wils., but is a different plant, with the leaves much less markedly complanate and generally much more robust. *Th. pumilum* in Wilson's Herbarium is a very delicate small plant with complanate leaves and frond. The chief difference, however, from a structural point of view, lies in the nerve, which in *Th. pumilum* is comparatively slender, tapering off and disappearing a long way below the apex; while in *Th. eflagellare* and *Th. latifolium* it is very stout, and scarcely tapers at all, ending abruptly close under the leaf apex. In this character *Th. latifolium* agrees with *Th. eflagellare*, while in habit and texture it is more like *Th. pumilum*, but of far larger size. *Th. eflagellare* really belongs to a different group, and is not very distantly connected with *Th. pandum*. I have received he true

Th. pumilum from Tasmania, where it was gathered on Mt. Wellington by Mr. W. A. Walker, in 1890, and at Russell's Falls, Russell's Falls R., Upper Derwent R., in 1909, sent me by Mr. J. A. Wheldon.

LEMBOPHYLLACEÆ.

CAMPTOCHÆTE RAMULOSA (Mitt.), Jaeg. Mt. Cook district (Murray, No. 70).

C. ANGUSTATA (Mitt.), Jaeg. Mt. Cook district (Murray, No. 100). I place this here with some hesitation. It agrees with a plant, collected by Knight, in Lindberg's Herbarium, and also with specimens in Bescherelle's Herbarium; but it has not (nor have they) the flattened secondary stems described by Mitten and Brotherus.

LEMBOPHYLLUM DIVULSUM (Hook. f. & Wils.), Lindb. Waitakarei Hills (Murray, No. 10). On wood, Mt. Cook district (Murray, No. 93), c.fr. This form has the leaves usually nerveless, though some leaves show a trace of nerve. The presence of a short single nerve in this species is usually held to be a crucial character; but it is not always reliable. I have had similar forms with the leaves more or less regularly nerveless sent me from Gippsland, Australia, leg. J. R. Murdoch, comm. G. Webster. In Wilson's MS. notes in his herbarium on the type specimen ("Gunn, 1686, Van Diemen's Land, *H. divulsum*, MSS.") he has sketched three leaves, one showing the single nerve, the other two nerveless, with the note: "fol. minutissime serrulata . . . . . ; sometimes nerveless; often faintly nerved halfway."

HOOKERIACEÆ.

DISTICHOPHYLLUM PULCHELLUM (Hook. f. & Wils.), Mitt. Waitakarei Hills (Murray, No. 22), c.fr. Hooker and Wilson in the 'Handbook' erroneously describe the seta as rough above.

PTERYGOPHYLLUM DENTATUM (Hook. f. & Wils.). Mt. Cook district (Murray, No. 131). A few fragments only. The distribution is generally Antarctic, but it has not been previously recorded from New Zealand. It is doubtfully distinct, however, from *P. nigellum* *.

* There seems no adequate reason for dropping the name *dentatum* under which the species was first published (*Hookeria dentata*, Hook. f. & Wils. in Lond. Journ. of Bot. 1844, p. 550). It is not clear why the name should have been altered to *denticulata*. That *dentata* was not a *lapsus calami* is evident from the original description: "foliis . . . . grosse dentatis," etc. It is referred to also in Fl. N. Z. ii. pp. 124–5 as "*H. dentata*, Hook. f. & Wils." Whatever the cause, *dentata* was the original name under which the species was published, and under which it should stand.

HYPOPTERYGIACEÆ.

CYATHOPHORUM BULBOSUM (Hedw.), C. Muell. Waitakarei Hills (Murray, No. 40).

CATHAROMNION CILIATUM (Hedw.), Hook. f. & Wils. Mauriceville, Wairarapa, North I. (Gray, No. 58), c.fr.

HYPOPTERYGIUM PALLENS (Hook. f. & Wils.), Mitt. Waitakarei Hills (Murray, No. 29).

H. FILICULÆFORME, Brid. Waitakarei Hills (Murray, No. 34).

RHACOPILACEÆ.

RHACOPILUM STRUMIFERUM, Hook. f. & Wils. Waitakarei Hills (Murray, No. 19), c.fr.

R. CRISTATUM, Hook. f. & Wils. Waitakarei Hills (Murray, No. 19 *a*), c.fr.

LESKEACEÆ.

THUIDIUM SPARSUM (Hook. f. & Wils.), Jaeg. Waitakarei Hills (Murray, No. 51).

TH. LÆVIUSCULUM (Mitt.), Jaeg. Near Hunterville, North I. (Burgess, No. 15); Lake Wakatipu, South I. (Meiklejohn, No. 2).

TH. HASTATUM (C. Muell.), Jaeg. Waitakarei Hills (Murray, No. 61). A single stem. Bush, Kaipara, near Auckland, North I., 1904 (Blackwell, No. 34). These plants agree with specimens of *Th. hastatum* in the British Museum, *e. g.*, Australian specimens, collected by F. Müller, in Hampe's Herbarium. The rigid habit, the deeply plicate, rigid stem-leaves, and the golden-red colour seem to have some distinctive value. According to Paris, Mitten made *Th. hastatum* a synonym of *Th. furfurosum* (Hook. f. & Wils.); but if the only evidence of this is the guarded statement in the 'Handbook,' it is rather too strong a conclusion to draw, though the plants are closely allied.

TH. FULVASTRUM (Mitt.), Jaeg. Lake Wakatipu, South I. (Meiklejohn, No. 4): det. Brotherus. A very striking plant in habit, whatever the structural characters may be worth. The branches are excessively crowded, tetracladous, and almost exactly uniform in length (roughly a quarter of an inch), so that the frond, 2–3 inches in length, is of a regularly linear-oblong compact outline; the stem is densely packed with crowded leaves and multiform paraphyllia (often approaching the leaves in size), rendering it very tumid and conspicuous on the under side of the frond. I cannot help thinking that the rather wide distribution for this species given in the 'Handbook' is somewhat illusory. There are no specimens in Wilson's Herbarium, and none in the British Museum Collection. It is probably rare.

?THUIDIUM DENTICULOSUM (Mitt.), Jaeg. Mt. Cook district (Murray, No. 97). A pretty little plant, mostly of a golden-green colour, seems to belong here, from the description, but I have not at present been able to see an authentic specimen of Mitten's plant. Dr. Brotherus writes that he has not seen Mitten's species and cannot therefore form an opinion of its identity with that. It resembles *T. læviusculum* (Mitt.), but has the nerve not cristate at the back, and the tips of the branch-leaves straight and not incurved.

HYPNACEÆ.

AMBLYSTEGIUM RIPARIUM (Linn.), Bruch & Schimp. In mud at the bottom of creek, Hunterville, north of Marton, North I., alt. 800 ft., Nov. 1905 (Burgess, No. 26). There can be no doubt of the identity of this with our *A. riparium*, of which it is an ordinary aquatic form. It has previously only doubtfully been recorded from Hawke's Bay (Colenso), *cf.* Handb. of N.Z. Flora, p. 482, and it is interesting to have its presence established. Although a fairly cosmopolitan moss, it does not appear to have at all a general distribution in the South Pacific.

DREPANOCLADUS BRACHIATUS (Mitt.). Mt. Cook district (Murray, No. 79); Kaipara, near Auckland, North I., 1904 (Blackwell, No. 38). This plant, which apparently does not find a place in Brotherus' work, varies somewhat in size and habit, serrulation of leaves, and basal areolation.

D. FLUITANS (Dill.), Warnst. Mt. Cook district (Murray, No. 82). A form somewhat intermediate between the groups *Amphibium* and *Falcatum*, having the habit of the former, but incrassate orange alar cells and a rather wide nerve.

D. UNCINATUS (Hedw.), Warnst. Mt. Cook district (Murray, No. 103, st.; No. 122, c.fr.).

ACROCLADIUM CHLAMYDOPHYLLUM (Hook. f. & Wils.), Broth. Mt. Cook district (Murray, Nos. 74, 108).

CAMPYLIUM RELAXUM (Hook. f. & Wils.), Broth. Mt. Cook district (Murray), ♂ and c.fr. The fruit of this species would appear to be rare.

STEREODON CUPRESSIFORMIS (Linn.), Brid. Waitakarei Hills (Murray, No. 6), c.fr.: two slightly differing forms. Waitakarei Hills (Murray, No. 30): a robust, densely pinnate form; leaves solid, acumen broad, one margin recurved.

Var. ELATUS (Schimp.), Mt. Cook district (Murray, Nos. 81, 106). This plant agrees very closely with our forms of var. *elatus*, and I think may quite safely be referred there. The var. *elatus* has not been recorded from New Zealand.

Var. FILIFORMIS (Brid.). Waitakarei Hills (Murray, No. 85). Growing on rocks; a very slender form with the leaves only slightly falcate, but with quite the habit of var. *filiformis*, and I think best referred there.

S. CHRYSOGASTER (C. Muell.), Mitt. Waitakarei Hills (Murray, No. 1).

ISOPTERYGIUM PULCHELLUM, var. NITIDULUM (Wahl.), Lesq. & James. Mt. Cook district (Murray, No. 78), c.fr. Both Brotherus and Paris exclude New Zealand from the distribution of this species, which is admitted doubtfully by Hooker in the 'Handbook'; the question simply being the identity of the plant with the European one. The characters, however, that Hooker gives in that work as distinguishing the New Zealand plant are only slight ones of habit, and, indeed, while they indicate a difference from *I. pulchellum* they accord exactly with the var. *nitidulum*, with which Mr. Murray's plant entirely agrees.

CATAGONIUM POLITUM (Hook. f. & Wils.), Dus. Mt. Cook district (Murray, No. 90); Mauriceville, Wairarapa, North I. (Gray, No. 60).

BRACHYTHECIACEÆ.

BRACHYTHECIUM RUTABULUM (Linn.), Bruch & Schimp. Waitakarei Hills (Murray, Nos. 3, 58), c.fr.

Var. ROBUSTUM, Bruch & Schimp. Mt. Cook district (Murray, No. 124). A closely pinnate plant, with large striate leaves, which seems best referred to this variety.

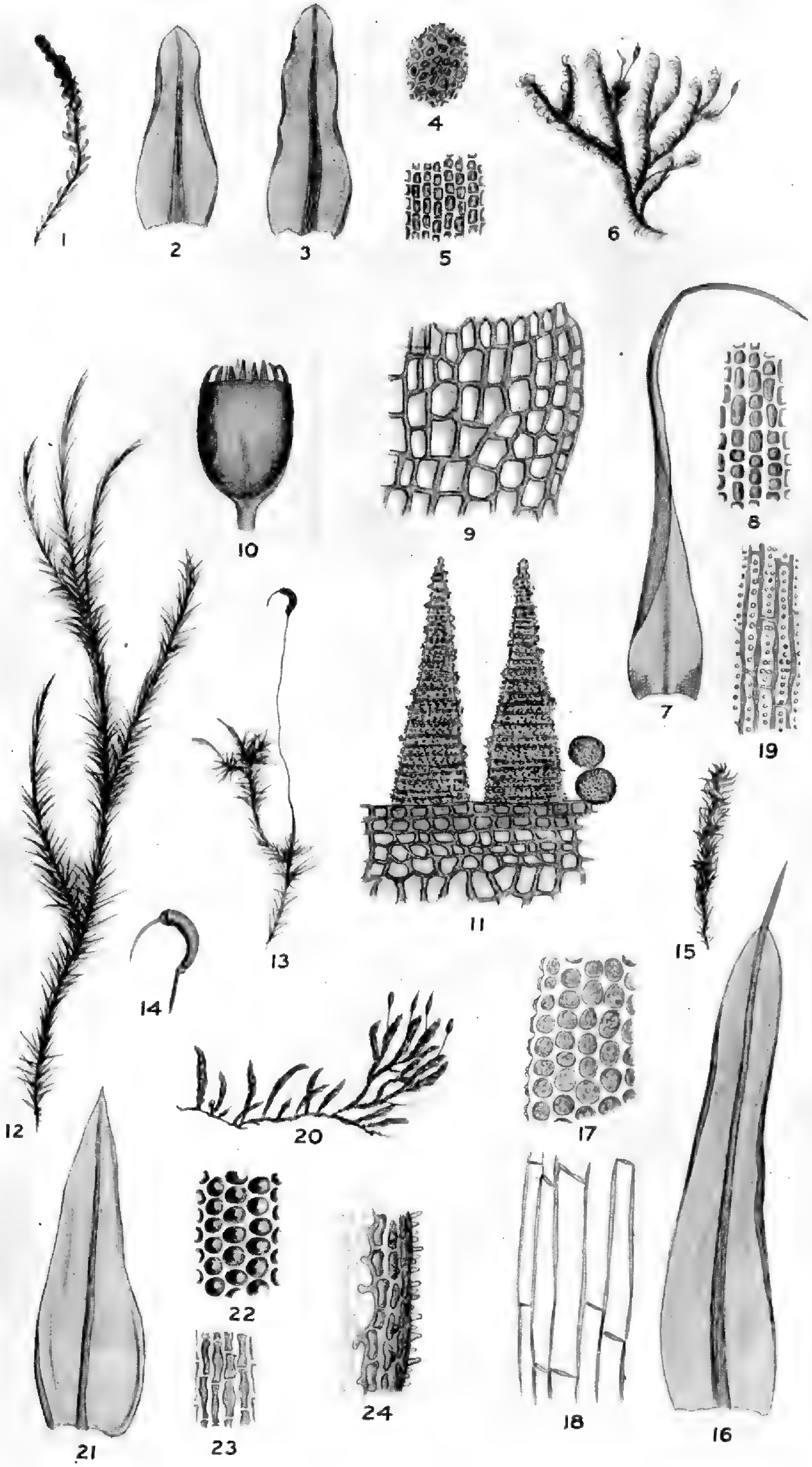
B. SALEBROSUM (Hoffm.), Bruch & Schimp. Mt. Cook district (Murray, No. 71). This appears to be new to New Zealand, though recorded from Tasmania *.

B. PLUMOSUM (Sw.), Bruch & Schimp. Mt. Cook district (Murray, No. 107).

B. PARADOXUM (Hook. f. & Wils.), Jaeg. Mt. Cook district (Murray, Nos. 73, st.; 88, c.fr.; 109, c.fr.). Some of the stems have the leaves almost erect and straight, when the plant looks much like *B. salebrosum*, with which it was growing; this is, however, distinguished by its finely pointed, entire or subentire leaves, as well as by the smooth seta.

RHYNCHOSTEGIUM ARISTATUM (Hook. f. & Wils.), Jaeg. Mauriceville, Wairarapa, North I. (Gray, No. 36), c.fr.

* Since writing the above I have received from the Rev. C. H. Binstead a specimen labelled "No. 393. *Hypnum salebrosum*, Hoffm., var. *integrifolium*, Broth.; on trees, Evans Bush, Kowai, Canterbury, N.Z., Apr. 1892; det. Brotherus; leg. T. W. Naylor Beckett." I am not aware whether the variety has been published.



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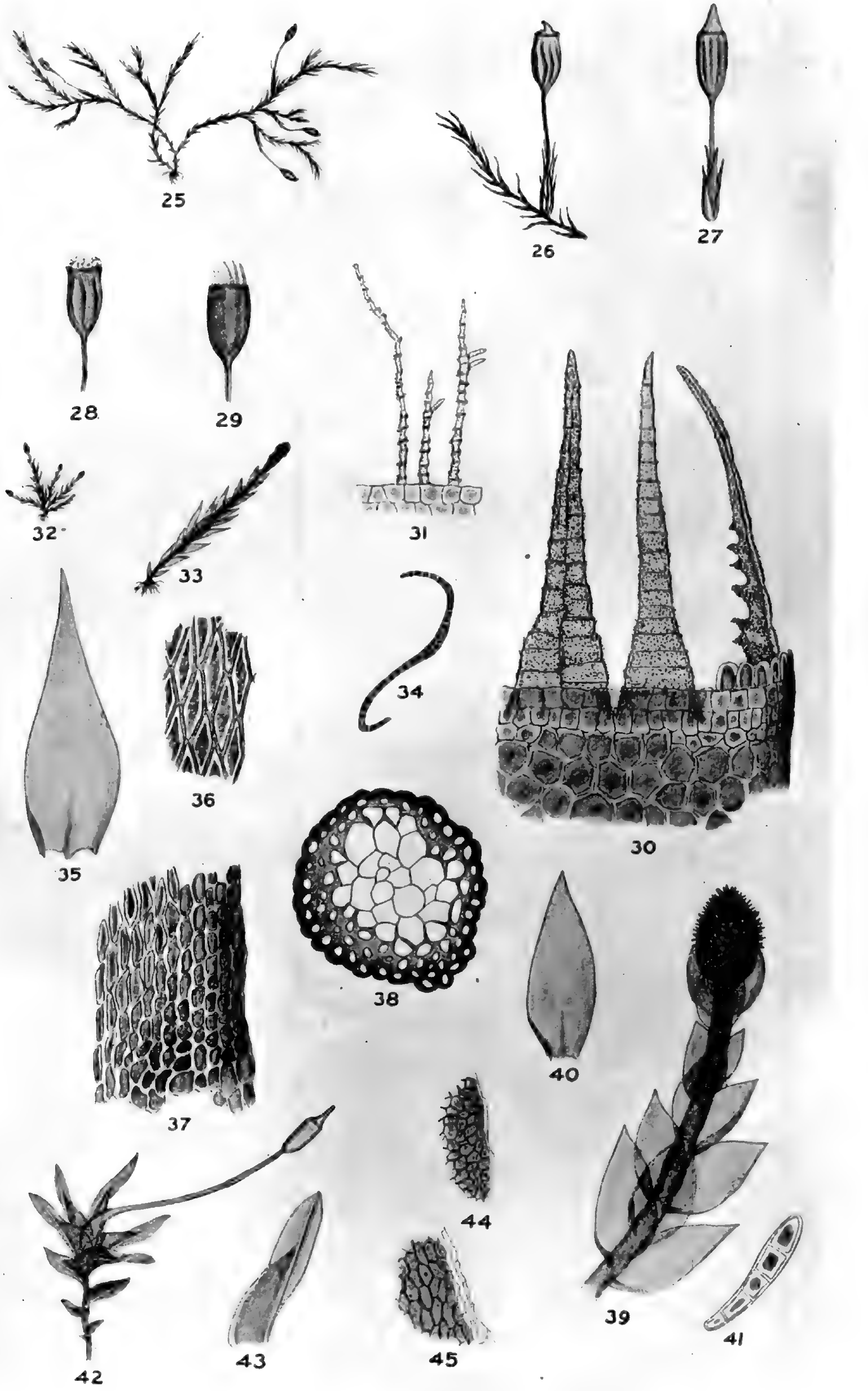
NEW ZEALAND MOSSES.



H. N. Dixon del.

NEW ZEALAND MOSSES.

HYPNODENDRACEÆ.

HYPNODENDRON MARGINATUM (Hook. f. & Wils.), Jaeg. Hunterville, North I. (Burgess, No. 28).

MNIODENDRON COMOSUM (La Bill.), Lindb. Waitakarei Hills (Murray, No. 15).

EXPLANATION OF THE PLATES.

PLATE 20.

Figs. 1–5. *Andreæa Michellii*, Broth. & Dixon.

Fig. 1. Stem (lower half moist, upper dry) × 2; 2, 3, leaves × 20; 4, upper cells × 200; 5, basal cells × 200.

Figs. 6–11. *Dicranum Mackayi*, Broth. & Dixon.

Fig. 6. Stem (one branch dry) × 2; 7, leaf × 20; 8, upper cells × 200; 9, alar cells × 200; 10, capsule × 30; 11, peristome and spores × 200.

Figs. 12–14. *Leucoloma Pungentella* (C. Muell.).

Fig. 12. Plant, natural size; 13, fruiting stem, nat. size; 14, capsule × 3.

Figs. 15–18. *Trichostomum grossirete*, Broth. & Dixon.

Fig. 15. Stem (dry) × 2; 16, leaf × 20; 17, upper cells × 200; 18, basal cells × 200.

Fig. 19. *Tortula rubra*, Mitt.; basal cells × 200.

Figs. 20–24. *Macromitrium rigescens*, Broth. & Dixon.

Fig. 20. Part of plant (dry), nat. size; 21, leaf × 20; 22, upper cells × 200; 23, basal cells × 200; 24, marginal cells near base × 200.

PLATE 21.

Figs. 25–41. *Tetraphidopsis Novæ-Seelandiæ*, Broth. & Dixon.

Fig. 25. Fertile plant × 2; 26, capsule (dry) × 4; 27, do. (moist) × 4; 28, do. showing peristome (dry) × 6; 29, do. do. (moist, inner to left, outer to right) × 6; 30, exothecium cells, annulus and peristome (left, dorsal view; mid, ventral; right, profile) × 200; 31, inner peristome × 200; 32, gemmiparous plant, nat. size; 33, branch of do. × 3; 34, leaf, transverse section near base, × 80; 35, leaf × 20; 36, upper cells × 200; 37, alar cells × 200; 38, stem section × 160; 39, branch with gemmæ × 20; 40, leaf from upper part of gemmiparous branch × 20; 41, gemma × 200.

Figs. 42–45. *Fissidens anisophyllus*, Dixon.

Fig. 42. Plant × 10; 43, leaf × 20; 44, upper cells × 200; 45, cells of vaginant lamina × 200.

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On the Structure of the Palæozoic Seed *Lagenostoma ovoides*, Will. By

THEODORA L. PRANKERD, B.Sc., University College, London. (Communicated by Prof. F. W. OLIVER, F.R.S., F.L.S.)

(PLATES **22-24** and 3 Text-figures.)

[Read 2nd May, 1912.]

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I. INTRODUCTION.

THE form-genus *Lagenostoma* was established by Williamson (**20**) for the reception of those seeds which were characterized, among other peculiarities, by the modification of the nucellar apex into a flask-shaped organ for the reception of pollen, which he termed the lagenostome.

Three species of his genus were distinguished by Williamson :—

(i.) *L. Lomaxii*, some sections of which he partly described in his MS. catalogue (now in the British Museum, S. Kensington), and which has since been fully dealt with by Oliver and Scott (**16**).

(ii.) *L. physoides*, to which he had previously referred as *Physostoma*, and of which a complete account has recently been given by Oliver (**14**) under that name.

(iii.) *L. ovoides*, of which, with *L. physoides*, he gave some description in 1877, based on preparations made with his own hands from the few specimens then available (**20**).

Two other species of *Lagenostoma* have been described (**1**) from impressions

only, i. e. *L. Sinclairi* and *L. Kidstoni*, though the latter has much in common with *Physostoma* (**14**, p. 112).

Since Williamson's original description many other specimens of *Lagenostoma ovoides* have come to light, and some preparations have been partially described and figured by several writers (Chodat (**5**), Coulter (**6**), Benson (**2**)).

The following account is based mainly on the collection handed me by Professor Oliver, of the Botanical Department, University College, London. This consists of preparations (numbered R. 20–R. 56*) from forty whole seeds and from four imperfect specimens. Two preparations have been made from the same seed in four cases, but there is unfortunately no series of three sections from the same seed—often of more value than a dozen sections from different seeds. This material was supplemented by the eleven specimens of the Williamson Collection in the Geological Department of the British Museum at South Kensington, which I was enabled to examine by the courtesy of Dr. Smith Woodward, F.R.S., and also by a few other preparations which are acknowledged when reference is made to them.

II. General Description.

A. *External.*

As its name implies, the seed is egg-shaped, tapering slightly towards the apex, and broadest about the middle. Williamson gave 0·16 × 0·1 (inch) for the dimensions, which were probably somewhat greater (about 4·5 × 3 mm.), as he had not sufficient material to construct an entirely median section.

Good transverse sections are not, strictly speaking, quite circular in outline, but obscurely polygonal (usually octagonal) (Pl. **23.** fig. 16), showing that the seed was slightly angled, the angles dying out a very short distance from the micropylar orifice. Radiating from the latter are a crown of tiny ridges, about 600 μ in length, and equal in number to, though much more prominent than, the angles, with whose direction they alternated. The ridges and angles died out at about the same level. The truncate base is rather more than a millimetre in diameter, and shows a very slightly prominent rim and a central papilla. There is very little trace of a layer of separation, and though, from analogy with *Lagenostoma Lomaxii*, a cupule was to be expected, no trace of any such organ has been recognized, though Chodat figures, without describing, what he terms the "arile charnu" (**5**, pp. 27 & 28).

* When more than one seed occurs on the same slide, it is referred to by a figure in brackets after the number of the slide, reading from left to right, and from above to below. Thus R. 48 (3) means the lower left-hand specimen of the four seeds which occur on this slide.

B. *Internal.*

The bulk of the orthotropous seed is occupied by the nearly spherical nucellus, which itself was almost entirely filled with the megaspore. As before stated, the nucellar apex was modified into a flask-shaped organ, the wall of which was bevelled, except at the base, in correspondence with the fluted internal wall of the micropyle, beyond which it projected, expanding slightly (Pl. **23**. fig. 9). The base was a trifle constricted, and the actual pollen-chamber, which frequently contains pollen-grains, was formed by the separation of the specialized wall of the lagenostome from the central cone of tissue. The crevice thus produced was, in mature specimens, in direct communication with the exterior, since the wall does not extend over the projecting tip of the organ, though whether it did so in the young condition there is no evidence to show. Closely investing the nucellus, and adherent to it for nearly three-quarters the length of the seed, is the integument, which thus far is a relatively simple shell, but above the point at which it becomes free from the nucellus expands into a somewhat complicated structure. The hard shell was continued as far as the micropyle, from which point it was reflexed upon itself, running inwards and downwards to the nucellus in the form of a fluted layer, the concavities of which were directed outwards. The form of this internal wall of the upper, free part of the integument cannot be better pictured than by the original simile of "an umbrella being opened against a gust of wind," the "ribs" of which are united to the shell towards the apex, but free below. A number of loculi, distinct above, though fused tangentially below, were thus formed, the radial septa of which were overarched by the external ridges. The actual number of loculi varies, but is usually 8, though it may be 7, and is rarely 6 or 9. It has been found possible to count accurately the number of loculi (or of vascular bundles) in twenty-three different seeds: of these, twelve showed 8 loculi, six had 7, two had 6, and two had 9; the remaining specimen, R. 20 *b* (1) (Pl. **23**. fig. 16), formed a pretty transition between the most usual numbers by possessing six normal loculi, and a seventh and eighth fusing to form a double loculus traversed by two bundles in close proximity. These two bundles are shown lower down side by side in the body of the seed in R. 20 *a* (1).

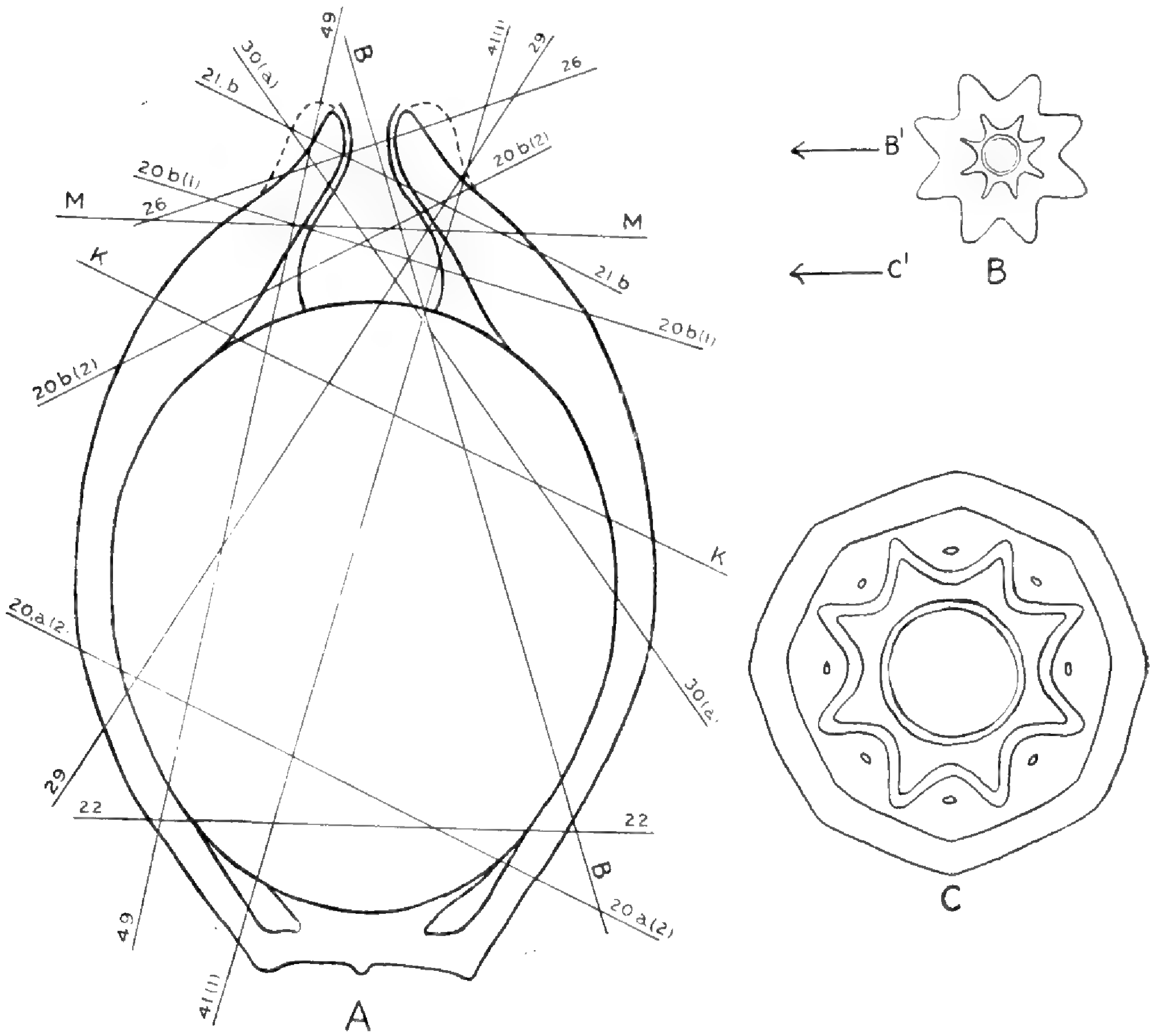
Lining the hard shell of the integument, where the latter is confluent with the nucellus, are a few layers of soft tissue, which were continued into the space between the two hard layers of the free part and up into the apical loculi. This tissue is very rarely preserved; it is well shown at the base of the seed in R. 20 *a* (1), and through the whole course of the upper part of the integument right into the loculi in the oblique section R. 20 *b* (1).

The vascular system is very simple: a single bundle enters the seed at the chalazal papilla, and, after traversing the hard shell, divides into a

number of branch bundles, which run in the soft tissue opposite the external angles and continue to the apex, one entering each loculus.

The general relations of the various parts of the seeds will be best under-

Fig. 1.



A.—Reconstructed median longitudinal section through the seed, upon which are plotted (approximately) the planes of all sections figured in the paper, except Pl. **23**. fig. 10 (imperfect) and Pl. **24**. fig. 31 (crushed) (× circa 30).

B B = section B. 8 from Battersea Polytechnic.
M M = „ 755 from Owen's College, Manchester.
K K = „ 1885 B in the British Museum.

All the other sections are from the U. C. L. Collection, numbered as explained on p. 462. (The letter R is omitted.)

B & C.—Transverse sections across A taken at the levels B′ and C′.

stood by reference to the above diagrams, and to Pl. **23**. figs. 9, 10, & 11. The planes of all complete sections illustrated in this paper are plotted on the

median longitudinal section, which is known to be approximately correct, since it accords with all available sections (except R. 28) within the limits of individual variation. That such occurred, as in recent plants, would be difficult to show directly, since it would require at least two sections, known to be cut in precisely similar directions through two different seeds; but it may be inferred from a comparison of the oblique sections R. 48 (2) and R. 51, which both pass through the base, the former cutting the bundle, while the latter does not. Now if the two seeds were identical in size, it is evident that the base of a section which passes through the bundle should be of greater dimensions than the base of any other section, assuming that the bundle enters symmetrically. This we are entitled to do both on comparative grounds and from the entire organization of the seed, although we have as yet no transverse section of the chalazal region. The base of R. 51 is, however, fully 7 % longer than that of R. 48 (2), which thus indicates that individual variation to the extent of, say, 10 % characterized these seeds. With this margin, all sections can be plotted on the median section except R. 28, which cuts the neck of the lagenostome, and yet from the configuration of the integument falls considerably below this point. As this appearance does not tally with any of the oblique longitudinal sections, we must conclude that it is abnormal, and that the whole lagenostome has been in some way dragged down into the body of the seed.

C. *Terminology.*

Owing perhaps partly to the fact that the delicate tissue of the integument was never preserved in any of Williamson's specimens, he did not recognize the latter as a definite unit of structure, but called the hard enveloping shell of the integument the "testa," and the inner fluted layer of the free part the "canopy."

The possession by seeds of a vascular system was not then a current conception, and it is curious to note that though in a subsequent memoir (**21**, p. 518) Williamson described and figured the "delicate prosenchymatous, barred or spiral cells" of a longitudinal section, he failed to grasp their true nature, or that they were identical with the cells of the "dark spot" (**20**, p. 239) he had seen in transverse section within each of the concavities of his "canopy" when first describing the seed, but considered them part of an inner layer of the testa.

We know now that vascular strands run in the integuments of many seeds, recent and fossil, so that their occurrence in *Lagenostoma* presents no difficulties; and, in the light of recent knowledge, it is scarcely possible to see in the chambered upper part of the integument other than the equivalent of the fused "tentacles" of *Physostoma*. Williamson's "canopy" is therefore nothing but the inner, and of the same morphological value as the outer

layer of a single structure of multiple origin. The term has since been applied to the whole of the free part of the integument (**16**, p. 203) and is so used in this paper.

It will be noted that the term *pollen-chamber* is used throughout merely descriptively of the space in which pollen is actually found. The term has been employed to denote the specialized apical portion of the nucellus, but now seems hardly appropriate, since this differs considerably from the pollen-chamber of recent seeds, and is the obvious homologue of structures in other fossil seeds (*cf.* (**15**) pp. 19 & 32) in which pollen has never been found. We therefore revert to Williamson's original designation of lagenostome for this organ.

In accordance with current usage, the term *plinth* is employed to indicate the convex, free part of the nucellus on which the lagenostome rests; and the modern terms megaspore and nucellar membranes are substituted for the old "perispermic" and "nucular."

III. Detailed Structure.

A. *Integument.*

It will be convenient to deal with the histology of the various regions of the integument under the following heads: (i.) the epidermis, (ii.) the fibrous layer, (iii.) the soft tissue, (iv.) the fluted lining of the canopy.

Of these, the first two form the shell which surrounds the whole seed practically unchanged from base to apex, while, as explained, the fourth only occurs in the upper third of the seed.

(i.) *Epidermis.*—This consists of a single layer of closely fitting, prismatic cells, which seem to have been serially arranged. The long dimension lies at right angles to the surface of the seed, and is about 45 μ, though it increased towards the apex, where the outer walls were usually convex, and often papillate (Pl. **23**. fig. 9), to as much as 70 μ. In surface view the epidermal cells were approximately square with an average breadth of 20 μ, though towards the apex they became somewhat broader tangentially to the micropyle. As usually preserved the cells have thick transparent walls and very dark contents, which in favourable cases may be seen to be in continuity with one another by very fine processes (Pl. **22**. fig. 3). It seems scarcely possible that this appearance is entirely due to mineralization, and that the actual protoplasts were not in continuity during the life of the seed, though it is probable that the processes of decay and fossilization have rendered this continuity more apparent (*cf.* Wieland (**19**), p. 135), in a manner comparable with modern laboratory methods employed for the same end—namely, by swelling the walls, thus rendering them more transparent

and darkening the cell-contents *. The middle lamella is possibly represented by the delicate line seen between adjacent cell-walls (*cf.* Oliver (**13**), pl. 43. fig. 22 and pp. 365 & 399).

In only one case (R. 22) has a different type of preservation been noted, and here the walls appear darker than the contents, which were apparently not very great (Pl. **22.** fig. 2). It is, perhaps, unnecessary to attempt to account for this appearance, since although the preparation is very perfect in some respects, the epidermis is not at all well preserved.

Even a small fragment of the epidermis of *Lagenostoma ovoides* would serve to distinguish the species from *L. Lomaxii*, since the cells of the former are much shorter and also quite destitute of the "pegs"—so usual a feature in the latter species.

It is, however, probable that there was a similar, if less elaborate, method of mucilage production. R. 20 *a* (1) and R. 22 show "blisters" on the epidermis projecting into the organic débris surrounding the seeds, recalling those of *L. Lomaxii* (**16**, p. 206), and probably analogously produced by the emission of mucilage—not from a specialized external layer, but by the epidermal cells themselves. In R. 41 (1) we have several stages in this mucilage excretion, where the cuticle is seen raised to varying heights (Pl. **24.** figs. 21 & 22). The slight raising of the cuticle over the papillate cells to the left is probably not an incipient stage, as the characteristic dark lines indicative of mucilage are not present. It has perhaps been raised by the expansion of the mucilage in its near vicinity; or, since the cuticle is sometimes found exfoliated from the epidermis for long distances (R. 40, R. 43) without any apparent mucilage excretion, it may, with these cases, be an effect of mineralization.

The mucilage in this species does not form distinct cones, as in *L. Lomaxii*, though it is possible that it was given off in spiral, rope-like bands, as in the recent seed of *Collomia*. This is suggested in R. 48 (3), and also by the dark transverse bars seen on the cones of *L. Lomaxii* (R. 8 *b*), indicating that the mucilage here may have had some such differentiation. In this connection we must remember that, as Oliver and Scott point out, we have probably in these seeds "a sporadic and premature manifestation of a phenomenon which normally became general only at a later stage in the history of the seed"; and this is borne out by the fact that in *L. ovoides*, as in their species, the discharge of mucilage, quite limited in extent, frequently occurs close to a local injury. (*Cf.* Pl. **24.** fig. 27, though the details are too small to be well seen.)

(ii.) *The Fibrous Layer.*—This is composed of thick-walled, prosenchymatous

* Decayed tissue, at least in its first stages, will sometimes show points of structure better than when fresh. I found that certain partially lignified cells in water-plants stained best in specimens where decay had obviously set in.

elements running parallel with the surface of the seed from the chalaza to the micropyle. As far as the integument is confluent with the nucellus, they are five or six rows deep, but they thin out in the canopy, and die out a little below the apex. In transverse section they are roughly circular in outline, or, as they fit closely, somewhat hexagonal by pressure, and measure 30 μ in diameter. In the absence of a truly median longitudinal section, it is impossible to get at their real length, and often difficult to measure the part of the fibre included in the plane of the section, but in a favourable instance this reached 350 μ, and many were probably much longer than this.

The impression given by most preparations, both transverse and longitudinal, is that the fibres were thick-walled, which, on general comparative grounds, one would expect. There are, however, several different types of preservation of this tissue: and, in the absence of those "critical histological investigations . . . . upon fossilized cells and tissues" to which Oliver has called attention (**14**, p. 89), it may be as well to consider them in detail.

(*a*) We have first what may be termed the ordinary type, where the walls are very thick, and only a small lumen is shown, which is sometimes obliterated (R. 20 *a* (2) & Pl. **24**. fig. 24). In this type narrow spaces are often to be seen between the elements, each space frequently showing a delicate line in the centre. This is probably an effect of mineralization, and means that the whole of the thickening layers have contracted away from the middle lamella. When the fibres possess no lumina, this is no doubt merely due to the greater thickness of the section, which if rubbed down further would probably show them.

(*b*) A striking contrast is afforded to the foregoing in the preparations R. 22 and 28, of which the former is a very beautiful, accurately transverse section across the seed near its base (Pl. **24**. figs. 27 & 28), and the latter an oblique section across the canopy. Here it will be seen that the walls of the fibres are comparatively thin, and that the cells occasionally show some contents as seen in Pl. **22**. fig. 2.

(*c*) In a third type of preservation (R. 20 *a*) the walls appear even thinner, but all the cells have thick, dark brown contents (Pl. **22**. fig. 1 *a*).

(*d*) Yet a fourth appearance is seen in preparation R. 21 *a* (Pl. **22**. fig. 1 *c*), where the walls are relatively thin, though very dark and decisive in character, the contents appearing almost black and confined to the centre of the cell, from which delicate striæ radiate.

The above types are fairly well defined, though some specimens show transitional characters, and there are many more where the preservation is not good enough to exhibit any particular type.

If we believe, as we surely must, that the above all represent a definite histological structure originally existing, our task is to discover what that was, and then to attempt a reconciliation of the varying appearances.

Taking first, broadly, the thick-walled (*a*) and the thin-walled (*b*, *c*, *d*) types above, it might be suggested that the latter corresponds to the original structure, and that the opposite appearance is produced by a post-mortem swelling of the walls. And this view might be considered to gain support from the fact that the best-preserved preparation (R. 22) is of the thin-walled type. But were this the case, the thick walls would scarcely be so heavily carbonized as they are, and might be expected to present the appearance already described for the more or less swollen walls of the epidermis (p. 466). Far more convincing evidence that the thin-walled is not the original type is, however, afforded by careful comparative observation of the character of the walls and contents. This has led to the conclusion that the fibres were originally thick-walled, and that the opposite appearance is produced by the peeling of the walls in layers, the end process of which is shown in R. 22 (Pl. **22.** fig. 2), where many of the walls may be seen to be split, in some cases a complete inner shell being formed. A pretty transitional case occurs in a broken bit of the shell found in preparation R. 36 (Pl. **24.** fig. 24), where the thick walls are seen to be laminated, which, according to this view, would be the first stage in the splitting and absorption of the walls. In some cells the walls are just beginning to split.

We have now to explain, as far as possible, types (*c*) and (*d*) as representing originally thick-walled cells. The dark masses in the centre of the cells in Pl. **22.** fig. 1 *a* were spoken of as contents; but this is probably only true descriptively as they stand, for these masses almost certainly do not represent the original contents of the cells, but rather the fused, disintegrated peelings of the walls. This is well shown by the series of transitional cases drawn in Pl. **22.** fig. 1 *b*, where the lowermost cell is seen to be very similar to those shown in fig. 1 *a* as typical for this preservation. In the uppermost cell, however, the dark "contents" are in the form of a thick ring with a large central space, and are most easily explained as being derived from the wall and as equivalent to several laminæ of the cells in Pl. **24.** fig. 24. The middle cell forms a transition from one condition to the other, the "contents" being contracted till only a small lumen is left, which in the lowest cell has entirely disappeared. The difference between this type and that in which the wall shows distinct layers (*b*) is probably that in the former case decay had gone a step further before the structure was fixed by mineralization. The last type (*d*) is more difficult to harmonize with the view here advanced. It is possibly a variety of (*c*), but it seems more likely that the very dark central spots do really represent the original cell-contents. This is supported by the fact that some of the laminated cells in the fragment of R. 36 show similar small black central spots, which it is difficult to interpret as other than representing the original protoplasts. If this is so, we must suppose that the inner layers of the wall have undergone a further stage of decomposition prior to fossilization.

There is occasionally some appearance of continuity between the contents of one fibre and another, and also between the contents of the fibres and the epidermal cells, but this is not so clear as in the case of the epidermis; and in view of the doubt as to what does represent the original protoplast, if indeed that be represented at all, we cannot lay much stress on these appearances.

The transverse section R. 22, already referred to several times, is quite unique in showing another feature of the fibres—*i. e.*, their modification in the immediate vicinity of each vascular bundle. Here they become more delicate, and are generally almost filled with pale brown homogeneous contents (Pl. **22.** fig. 2). Some differentiation of the cells exterior to a vascular bundle—*e.g.*, the storage of starch—is often shown in recent plants; and though it would seem impossible to arrive at the precise physiological significance of the appearance described above in a fossil plant, we at least know that such is definitely indicated, for the occurrence of specialized cells seven or eight times in connection with an unmistakable vascular strand is too great for mere coincidence.

(iii.) *The Soft Tissue.*—As before stated, this is seldom well preserved, but since it is clearly shown in a few preparations, and indicated in many others from which it has mostly disappeared, we must conclude that it was a constant feature.

It is greatest in extent in the canopy, where it formed the filling tissue of the chambers (Pl. **23.** figs. 15 & 19), which in their greatest extent measure about half a millimetre radially in a transverse section. From the point where the cusps of the canopy lining cease to touch the outer shell the masses of filling tissue become tangentially confluent, and when the integument unites with the nucellus the soft tissue continues as a layer a few cells broad, forming a lining to the shell, and perhaps represents the "inner flesh" of Cycadean seeds. The specimen 1885 B (text-fig. 2, p. 473) in the British Museum, and to a lesser extent R. 21 *a*, show that the slight angling which was mentioned (p. 462) as an external feature of the seed is visible also in the internal boundary of the shell, and, since the nucellar membrane is circular in section, the soft tissue is wider in extent just opposite each external angle. These columns of tissue may thus be regarded as slight downward continuations of the canopy chambers. At the base of the seed the soft tissue is again better developed, filling up the space between the fibrous layer, the nucellus, and the tracheal plate (*cf.* A, p. 464). The only section in which it can well be studied in this locality is R. 20 *a* (2), the plane of which, though oblique to the axis of the seed, cuts the shell almost at right angles, owing to its curvature near the chalaza (*cf.* plotting on A, p. 464). The tissue here has the appearance of parenchyma, the cells of

which are roughly circular in outline though of very different sizes, varying from 20–50 μ in diameter. The cells are all thin-walled with intercellular spaces, and occasionally show pale brown contents.

There is no section across the body of the seed where the soft tissue is well preserved: it is indicated at one place in transverse section (R. 24), and in one or two longitudinal sections such as R. 48 (2) several wavy outlines within the fibrous layer represent its disorganized remains. Most oblique sections of the canopy have traces of the filling tissue, and in the second of the exquisitely preserved seeds in R. 20 *b* it is perfectly shown. In this section we see at a glance that the soft tissue was not really parenchyma, since comparatively few transverse walls are seen across the delicate elements, which were elongated in a direction parallel with the wall of the seed. The cells are more uniform in size here than at the base and measure 20–25 μ in diameter. As in the case of the fibres, it is not possible to determine their length in the absence of a suitable preparation; but in one oblique section an element was found at least 170 μ long, and they perhaps reached a greater length than this, though the impression is given that they were not so long as the fibres.

In very many sections there is in the remains of this tissue a well characterized type of cell, which will be here termed the secretory sac. Pl. **22**. fig. 6 shows two of these elements with a little of the adjacent tissue, occurring at the base of R. 41 (2). The walls are always very thin, and generally pale, though distinct. The contents are very dark indeed, and almost, if not quite, homogeneous, a very small space being left between the contents and the wall usually around its whole extent. Although, of course, it is impossible to be sure what secretory sacs should look like in a fossilized condition, yet this appearance is quite what one might expect. The homogeneity of the contents suggests that nucleus and plastids, etc. had disappeared, giving place to a substance or mixture of substances rich in carbon, and easily breaking down with heat, such as sugars and some organic acids, which are just what is found in the secretory tissue of recent plants. The thin walls also accord with the secretory nature of the cells in question. The sacs are well shown in the British Museum slide 1885 B (text-fig. 2, p. 473); and in sections of the roots of the plant, or close relation of the plant, which bore our seed, occurring on the same slide, cells of precisely similar general characters are found which are stated by Scott (**17**, p. 239) to be probably secretory sacs. The same well-defined type occurs constantly in the débris round the seeds—for instance, in sections of pinnules (*cf.* Pl. **23**. fig. 10) which were very probably the foliage of the plant bearing the seeds, and it is difficult to think of any other type of cell which these elements could represent. The sacs, which are often of considerable length, 75 μ or more, are irregular in shape, and seem to occur on the outer and inner limits of the soft tissue in the canopy.

They are especially well shown at the base of the seed, and are also found in connection with the bundles *.

(iv.) *The Fluted Lining of the Canopy.*—There is little to add to the general description already given of this structure, since histologically it is similar in most respects to the outer shell, though seldom so well preserved. Like the former it is composed of two layers—the fibrous, abutting directly on the parenchyma, and the innermost layer of the whole structure, which lines the sinus surrounding the lagenostome. The fibrous layer is here only one to two rows deep, and seems, so far as can be made out, in all respects similar to the corresponding layer of the outer shell, with which it is continuous at the cusps in its upper part—dying out in the same way just below the apex. The innermost layer is a directly infolded continuation of the epidermis of the seed, with which it seems to agree in all particulars, even to the papillate nature of the free, inwardly directed walls of the cells near the apex.

B. *The Vascular System.*

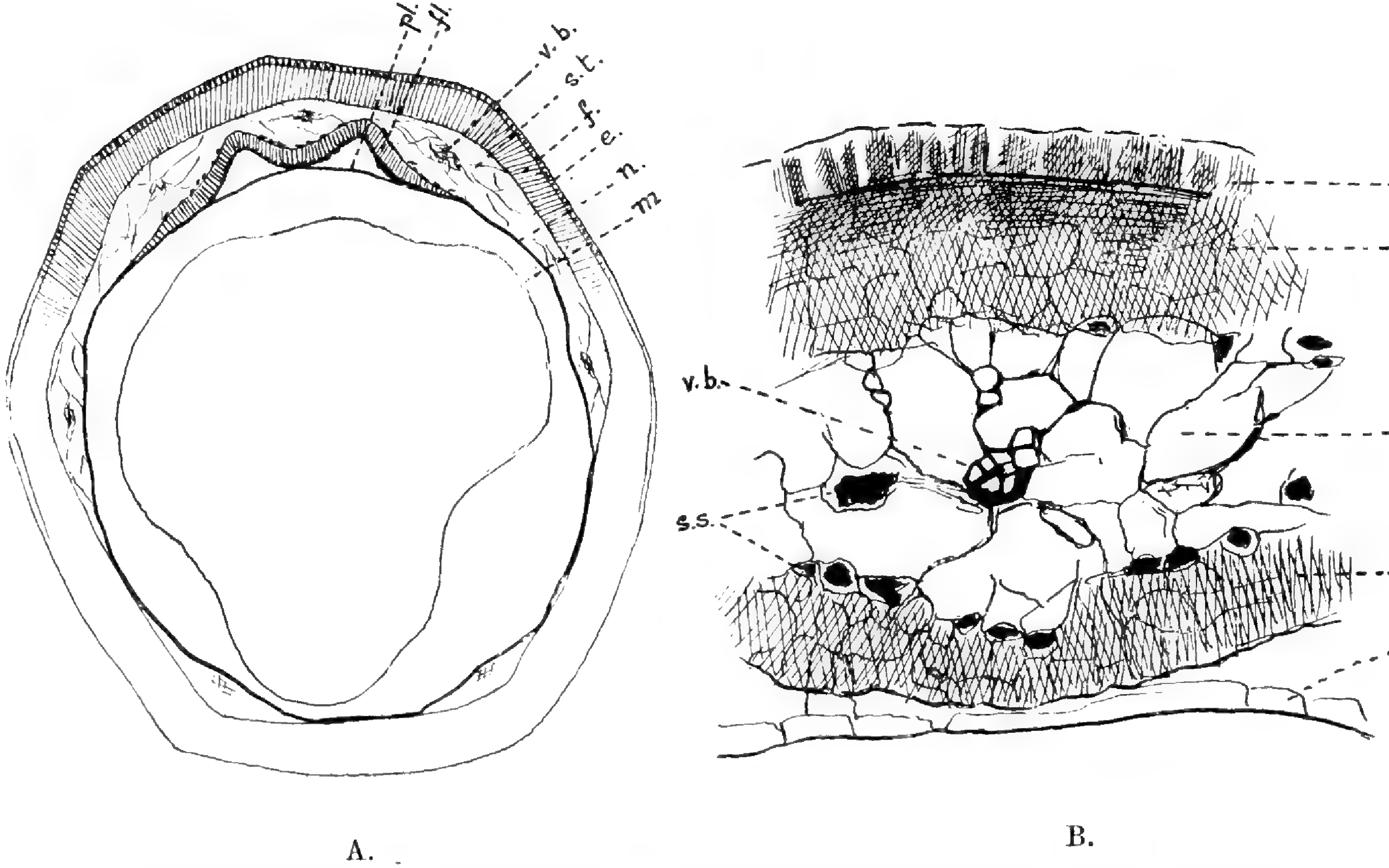
It is to be regretted that we have no transverse section across the chalazal region, but, from analogy with *L. Lomaxii*, supported by the fact that no section of *L. ovoides* ever shows more than one bundle at the base, it is practically certain that a single bundle entered the seed at the central papilla, though such details as the position of the protoxylem, whether the wood was a solid strand or not, etc., are necessarily lacking.

The main bundle almost immediately divided up into a number of strands (usually 8), which ran in the soft tissue opposite the external ribs, one entering each loculus of the canopy.

The main strand was composed of tracheids, and was apparently surrounded by a little parenchyma, but it is impossible to trace any true phloem. Around the branch strands at their base is a considerable amount of sclerotic tissues, and a definite tracheal plate, though not so pronounced as in *L. Lomaxii*, is thus formed at the base of the nucellus (*cf.* A, p. 464, and fig. 10). In transverse section the vascular strands are lenticular in outline (Pl. **24**. fig. 28), measuring on an average 125 μ long by 40 μ broad, and thus seem to occupy a midway position in size between *Physostoma* and *L. Lomaxii*, the measurements for which are given as $50 \times 30\ \mu$ for the former, and $160–176 \times 60–70\ \mu$ for the latter. It should, however, be remembered that lacunæ, possibly representing the phloem (**14**, p. 96), accompany the

* It may be recalled that the secretory sacs in *Physostoma*, while agreeing fairly closely in size with those of our seed, are described as tabular in form and assigned to nucellar, not integumental tissue (**14**, p. 97).

Fig. 2.



A.—Oblique transverse section showing the angling of the shell and the downward prolongation of the soft tissue (×30).
B.—Enlarged sketch of the central canopy chamber of A to show secretory sacs. (Reference letters as explained on p. 488.)

bundles in *Physostoma*, so that the true dimensions of the latter may be somewhat greater ; and, further, that the limits of fossil vascular strands are not always sharply defined, and might be interpreted differently by different observers.

Histologically the bundles are composed of six or eight tracheids with a few secretory sacs and thin-walled elements, probably parenchyma, of much smaller dimensions than the cells of the soft tissue around (Pl. **22**. fig. 2 and Pl. **23**. fig. 20). It is only occasionally, however, that even this much detail is evident, for the bundles are often dragged from their normal position, and sometimes more or less obliterated, or absent altogether. The tracheids were scalariform and about 15μ in diameter; it seems very doubtful if there was any definite protoxylem. So far as can be made out, slightly smaller elements occur in any position, but, in view of the fact that smaller elements are not necessarily protoxylem, and the impossibility of determining the real sequence of formation, we are of necessity left very much in the dark as to the nature of the bundle in this respect. In R. 48 (1) a bundle in longitudinal section seems to show a smaller internal element (Pl. **22**. fig. 4), but it is difficult to say that this is not merely a tracheid of equal size cut tangentially. One of the bundles in R. 41 (1) shows on its inner side what may be interpreted as a loose spiral, but is, by itself, scarcely convincing.

So far as any reliance is placed on the above, it will of course point to the endarch nature of the bundle. Towards the apex of the seed the bundles thin out to two or three elements, and apparently die out at about the level where the ribs end and the ridges begin.

A word more may be added with regard to the apex, before passing to the detailed description of the body of the seed. As the apex is approached, the bundles and fibres diminish, the former appearing to die out before the latter, though it is impossible to give an exact description of the point without the appropriate section. Bundles apparently die out in all sections, but this is of course due to obliquity—the plane of the section and that of the bundle never exactly coinciding. Owing to this, and also to the frequent displacement of the bundles, one could not easily be certain that the ending of the bundle was present, even if that were actually the case.

Near the apex, the tips of the loculi, bounded by the inner and outer epidermis, seem to contain soft tissue, though apparently thicker-walled than the corresponding tissue in other parts of the seed (Pl. **23**. fig. 17). Secretory sacs are present, but in no section passing through this region does there seem to be any indication of hydathodes, nor is there any differentiation of the apical epidermal cells, such as a thinning of the cuticle, which would lend any support to the idea that the apices of the canopy chambers were porous, as was once suggested (**13**, p. 462).

Right at the apex, the cusps of the canopy lining fit into the external ridges, the inner and outer epidermis nearly, if not quite, meeting at these points (Pl. **23.** fig. 14 and Pl. **24.** fig. 34). The soft tissue has thus quite disappeared, and it is therefore clear that the micropylar grooves are not due to "contraction or collapse of the filling tissues of the chambers," as it has been thought possible for *L. Lomaxii* (**16**, p. 105), nor to any superficial modification which petrification might possibly induce, but are a perfectly definite feature in the structure of the seed. It does not seem to me likely that the apical grooves and ridges are even exaggerated, far less produced by post-mortem changes.

C. *The Nucellus.*

A description of the nucellus resolves itself into that of the lagenostome and plinth, since in no preparation is there any further trace of the megasporangium, with the exception of the thick, structureless, nucellar membrane. Although described as confluent with the integument as far as the plinth, which it undoubtedly was in life, this membrane is frequently seen to be torn away from the soft tissue—more often than not dragging the bundles with it. As it is usually crumpled, parts of the membrane are sometimes caught in surface view, when a pitted appearance is generally presented; but it is doubtful if this is other than an effect of the impregnating mineral. Indeed, the entire nature of the nucellar membrane is a matter of uncertainty: *i. e.*, was it originally a thick membrane, or does it represent a broken-down tapetal layer?

The lagenostome is about 1 millimetre long, and ·8 mm. in its greatest breadth. The central cone is mainly composed of thin-walled, roughly spherical cells, about 40 μ in diameter, between which intercellular spaces occur. A good transverse section across the body of the lagenostome shows a central group of six or eight cells (Pl. **23.** fig. 16), which are much smaller, being only about 20 or 30 μ in diameter; and a few longitudinal sections reveal that these cells reached a length of at least 100 μ, and together formed a median column, extending from the base to a distance varying from one to two thirds the height of the lagenostome. The whole of the apex of the central cone is modified by having the cell-walls strongly thickened to a varying distance in a downward direction, with the result that a dark tongue-shaped mass was formed, the central cells of which were elongated at least in the lower part. None of the cells of the central cone seem to show contents.

As before stated, the central cone is detached from the outermost layer of cells or wall of the lagenostome to form a space which is the actual pollen-chamber. It is not, however, perfectly clear that this space was always continuous around the organ in its whole extent. Many sections

show the central cone touching the outer wall (Pl. **23**. figs. 11–15, and particularly fig. 17), and in such cases it is a matter of great difficulty to determine whether there is mere contact or actual continuity of tissue. The subject is referred to later (p. 484).

As in *L. Lomaxii*, the wall of the lagenostome is bevelled to correspond with the crenulations of the canopy, but this bevelling is not found either on the neck or at the base of the organ. The wall is one layer of cells thick, and, when well preserved, exhibits a very interesting structure.

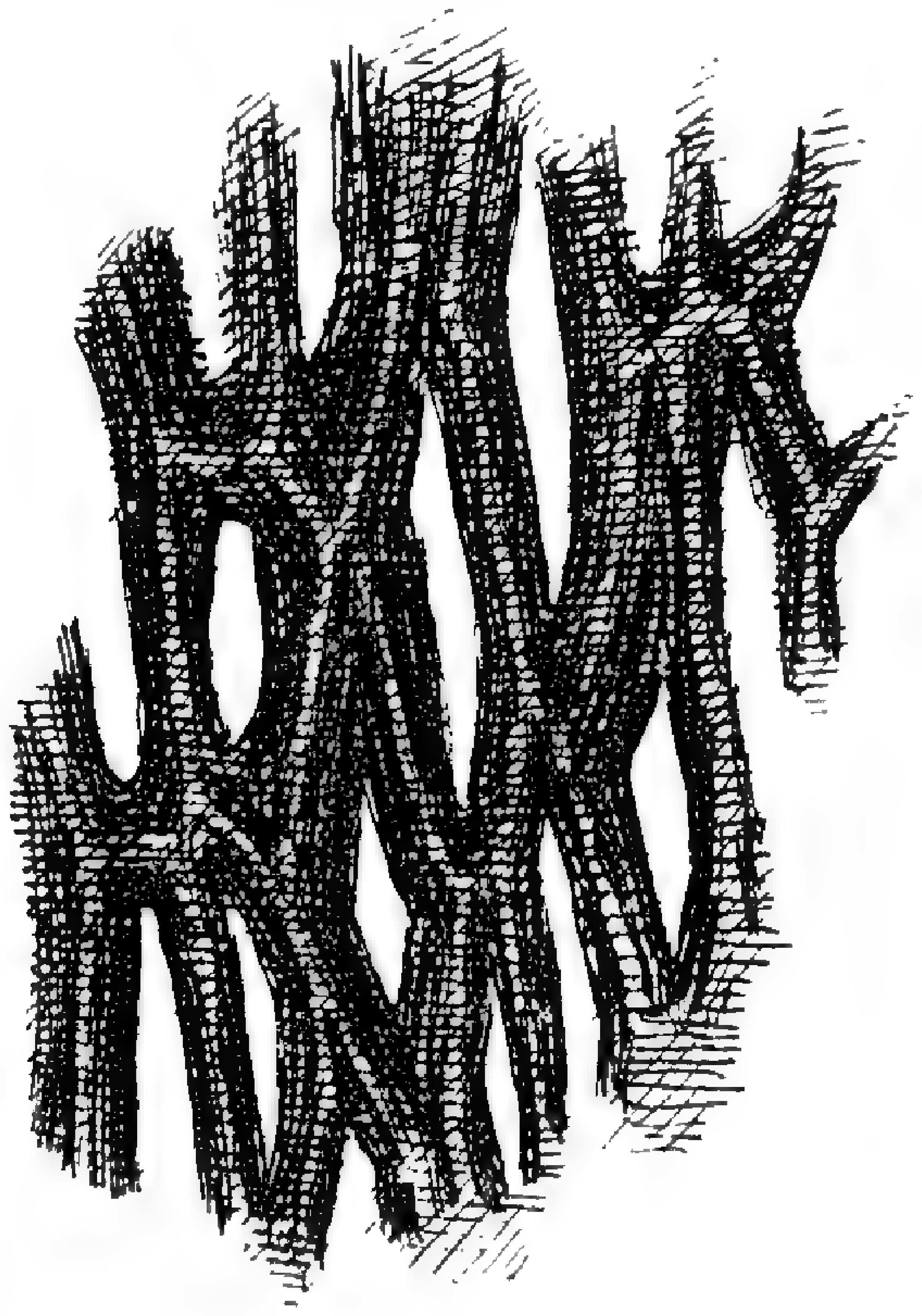
A beautiful transverse section (R. 755) * from Owen's College, Manchester, kindly lent by Prof. Weiss, shows that the radial walls are enormously thickened in a manner reminding one of an exaggerated endodermis (Pl. **24**. fig. 29). The cells measure 16–18 μ tangentially, and the thickenings are about 12 μ, sometimes reaching as much as 16 μ broad, so that they are often laterally in contact. The thin outer walls of the cells are for the most part strongly curved (usually outwards, but sometimes inwards), so that the possible tangential extension of the cells is considerably greater than the above. These curved outer walls are well shown in transverse section in Pl. **24**. fig. 30, and in longitudinal section in Pl. **23**. fig. 9. The inner walls are rarely present. By careful focussing it may be seen that the tongue-shaped radial thickenings are frequently double, and a surface view of the wall, obtained from the specimen 1435 (2) in the Williamson Collection (text-fig. 3, p. 477), explains this appearance. It is here seen that the cells are elongated, with tapering ends fitting closely into one another, and that their walls are strengthened by thick bars which do not quite reach the middle partition. This double nature of the bars (obliterated in many sections, but indicated in R. 45), together with the shape of the cells, explains why the thickenings so frequently seem two-lipped in transverse section, and also their variability in size and proximity, which is largely due to the varying levels at which the cells are cut. One of the most interesting points in the structure of the seed is the fact that the epidermis of the lagenostome is directly continuous with, and of the same character as, that of the plinth. This forms a circular belt about $\frac{1}{3}$ mm. broad, curving slightly from the base of the lagenostome to that of the canopy, but is not bevelled as in *L. Lomaxii*. Owing to its small size it is not so frequently cut as many parts of the seed, and when it is included in the plane of section this is not usually the best to exhibit its structure.

The only surface view of the plinth is in R. 20 *b* (2), fig. 19. R. 49 (Pl. **24**. fig. 32) is a very good preparation for demonstrating that the epidermis of the plinth was similar to that of the lagenostome. In the first place, it is easy to be sure of the exact plane of this section, because it is

* This specimen gave the key to the interpretation of the structure described, but it may be partially made out in several of the University College, London, slides, *e. g.* R. 20 *b* (1), fig. 16.

seen that it shaves the canopy lining without touching the lagenostome, and we know, therefore, that the plinth in its central part is cut exactly tangentially to the axis of the seed (*cf.* its plotting on p. 464). In this region we see that the vertical walls are strongly thickened, while the thin horizontal (external) walls are curved inwards (Pl. **24**. fig. 33). On either side the projecting vertical bars may be seen of cells which have either lost their outer horizontal walls or, more probably, these have sunk inwards so far that they are not readily discernible. The bars are about 9 μ across, and are thus seen to be less thick than those of the lagenostome, with which, however, they are in direct continuity. This is well shown in several fortunate sections, whose planes include the junction of the plinth and the lagenostome (R. 27, R. 46).

Fig. 3.



Surface view of part of lagenostome wall ($\times$ 360).

The epidermis of the plinth was thus composed of radially elongated cells with thickened vertical walls, and apparently lay directly over the nucellar membrane.

D. *The Pollen.*

There is little to say under this heading, for though the pollen leaves nothing to be desired in quantity, the same cannot be said in respect to its quality. It occurs in several slides of the Williamson Collection and in many preparations belonging to the University College Collection, but is never really well preserved.

The grains are oval in form, and their dimensions have been given by previous writers. My measurements give an average of $72 \times 53\ \mu$; but this is certainly an underestimate of the length, as the grains are not all cut in the planes of the major axes. No doubt the grains of those days varied as much among themselves as do those of ours, and some reached as much as $90\ \mu$ in length.

With regard to structure, little more can be made out than that the grains had thin places in their walls. Some appearance of a network is frequently seen (Pl. **22.** fig. 5 *b* and Pl. **23.** fig. 19), but in no single case does it seem possible to refer this with certainty to a cell reticulum; it seems quite as likely to represent surface markings. Still less is there any trace of germination. In R. 38 (Pl. **22.** fig. 5 *a*) there is in the pollen-chamber an oval body measuring only $68 \times 35\ \mu$, which, instead of showing the usual reticulate markings, is of a uniform dark brown with extremely fine dots. It is perhaps a foreign pollen-grain.

A word may be added as to the position of the grains. Not any have ever been found in the sinus between the lagenostome and the canopy. Within the pollen-chamber they tend to occur towards the base, and in five cases have been found resting on the megaspore membrane or where this would have been in life. Sometimes they appear more or less embedded in the tissue of the central cone, a state of things probably due to post-mortem changes in the position of the latter. R. 28 affords the solitary example of a pollen-grain occurring in the neck of the lagenostome, and in R. 30 *a* (Pl. **24.** fig. 34) we have a grain outside the seed situated in an apical groove. In a few other cases bodies have been seen near the apex which may have been pollen-grains, but in the surrounding débris it is very difficult to be certain on this point.

E. *The Prothallus.*

Williamson referred to a central body in one of his sections as possibly a prothallus, but more probably an effect of mineralization, and Chodat asserts that the existence of a prothallus has not been demonstrated in *Lagenostoma* (**5**, p. 30). The preparation from which Williamson's figure ((**20**) pl. 10. fig. 68) was drawn has not been traced; but whether it showed a prothallus or not, we now have, in addition to the numerous sections which show the thick megaspore membrane, no less than four slides (R. 24, R. 29, R. 42, and R. 44) which have strong claims to have preserved the actual substance of the prothallus.

The megaspore membrane, usually more or less contracted and crumpled, has very much the same appearance as that of the nucellus, with which it is often in contact, sometimes so closely as to be indistinguishable. Again, like the nucellar membrane, it has frequently a pitted appearance.

In R. 29 (Pl. **23**. fig. 11) and R. 44, just within the megaspore membrane, small groups of carbonaceous material are seen, and in R. 24 (Pl. **23**. fig. 18) there is much the same appearance, only that within this layer, which is here multiseriate, is another of similar masses pale brown in colour, while the outer are black. The inner die out towards the centre. The megaspore of R. 42 is entirely filled with these cell-like masses, and in places, particularly at the base, thin streaks appear between them. It is difficult to resist the inference that we have in these preparations three stages in the formation of the prothallus: the lining layer of carbonaceous groups may represent the first stage, where, as in recent Cycads (**6**, p. 132), a parietal cytoplasmic layer with free nuclei is first formed; we then have this spreading inwards in R. 24, where the lighter colour may indicate the younger nuclei; and finally, in R. 42 the whole megaspore is full of nuclei, the fine streaks suggesting the beginning of partition walls. Indications of a cellular tissue within the megaspore membrane are also shown in the section 1429 of the Williamson Collection, and Bertrand (**4**) has already noted the occurrence of "membranes cellulaires" in the endosperm of some silicified seeds.

It is probable that the archegonia of the Lagenostomeæ were situated at the base of the pollen-chamber (*cf.* Oliver (**12**), fig. 9, pl. 24), and in R. 39 a dark brown mass occurs, which is certainly suggestive of an archegonium. It is true that dark masses of similar size occur promiscuously in other parts of the seed (Pl. **24**. figs. 32 & 33), but these have more the appearance of a fungal origin.

F. *Fungus.*

No description of the material available would be complete without an allusion to the fungus which several preparations show infesting the decaying seed, though for a full elucidation we must no doubt await the palæomycologist of the future.

(i.) *Mycelium.*—This is shown to its greatest extent in R. 29 (Pl. **23** figs. 11 & 13), where the hyphæ ramify in all the soft parts of the seed, *i. e.* prothallus, nucellar cone (though not in the dark apical portion), and canopy chambers. They are extremely fine, perhaps 2 μ across, and are so closely interwoven that it is almost impossible to determine such points as to whether or not they were septate, branched, etc. Very probably they were both, for in some preparations where hyphæ occur singly these points can be satisfactorily demonstrated, R. 40 (1) (Pl. **24**. fig. 25) showing a septate and R. 49 (Pl. **24**. fig. 23) a branched hypha. But of course it is impossible to be certain in these cases that one is dealing with the same fungus. The hyphæ in the two latter cases are stouter, measuring 4 μ across.

(ii.) *Spores* *.—Two very distinct types of spore occur in several seeds which perhaps belonged to two different species or genera of fungus. The smaller of the two, about 18 μ in diameter, are covered with exceedingly fine hairs or spines (Pl. **22**. fig. 8), and thus far recall the fossil spores described by Oliver (**11**), only that the latter are found in a definite fructification, while the former always occur singly. Considerable interest attaches to the second type, as in several cases they seem to be germinating. In diameter some reach as much as 30 μ, and are smooth-walled, though sometimes a little crumpled. In some cases there is a single germinal tube (Pl. **24**. fig. 31), though in others two are shown from opposite ends of the spore (Pl. **22**. fig. 7 and Pl. **24**. fig. 26). This may mean that we have two different species present, or it may represent two stages in germination, or, again, two different methods in the same species, since we know how variable are recent fungi in this respect. One of the germinal tubes shown in fig. 26 (Pl. **24**) has already branched twice.

IV. The Nield Specimen.

Among the several seeds ground down by Williamson was one belonging to Nield and described as a *Lagenostoma ovoides*, which, though undoubtedly of that genus, does not seem to belong to the species *L. ovoides*. The configuration of the sections given in pl. 3. figs. 71–73 of the VIIIth Memoir (**20**) show that, as stated in the text, they are transverse, figs. 72 and 73 being cut at the base of the lagenostome. The precise dimensions of the seed at this level can only be approximately determined from the preparation (Will. Coll. 1433), since most of the outer shell has disappeared, but the diameter could not have fallen far short of 4 mm. It was probably about 3·7 mm.; and since the diameter of *L. ovoides* at the base of the lagenostome is about 2 mm., the dimensions of this seed are 85 % greater than, or roughly double, those of ours—a quantity far beyond the limits of individual variation (*cf.* p. 465).

Further, though this point is of perhaps little significance by itself, the specimen shows decisively ten loculi (**20**, fig. 71), while no seed of our species that has come under my notice shows this number, and in only two certain cases (R. 29 and 1436 Will. Coll.) are there as many as nine (*cf.* p. 463).

In the absence of the shell it is impossible to know if it were angled in the manner so characteristic for *L. ovoides* (*cf.* R. 27, R. 28, R. 53, etc., Pl. **23**. fig. 16 and text-fig. 2), but the single fragment marked "A" in pl. 3. fig. 72 indicates that it was not so. Possibly the whole width of the

* The term is of course used provisionally, though it does not seem possible to refer the bodies in question to any other category.

shell is not shown here, though, if not, the diameter at this point must be still greater than that given above.

But if this seed is not *L. ovoides*, the question arises as to what other species of the genus it belongs. The great size of the particular section we possess seems to preclude its identity with any known species of *Lagenostoma* except *L. Lomaxii*, but that is what we should expect for a section across the base of the lagenostome of this species, at least one specimen of which may have possessed ten loculi (**16**, p. 210).

As militating against its inclusion in this species, however, is the fact that although the section is cut at its base, the wall of the lagenostome is very distinctly crenulated, while Oliver and Scott state that the crenulations died out towards the base of the organ (**16**, p. 200).

There remains one further feature to note in this curious specimen, *i. e.* the intrusion of the megaspore membrane into the lagenostome. That this is actually the case, and that the appearance is not due to a slight obliquity by which the membrane is shaved towards the lower part of the section, is shown by the fact that, were this so, the plinth must of necessity be cut, and would be seen united to the canopy (*cf.* Pl. **23**. fig. 15), whereas in reality the lagenostome wall is quite complete, forming a rough circle. The dimensions also, so far as they can be obtained, agree with the completely transverse nature of the section, which is, indeed, what it is stated to be (**20**, p. 239).

The megaspore membrane normally intruded considerably into the lagenostome of *Physostoma*, but no instance of its doing so in a *Lagenostoma* has been recorded, while numerous specimens show it contracted away from the nucellus. Perhaps the preparation may best be explained in this particular as that of a seed abnormal in the opposite direction to that of R. 28 (p. 465), only that while it is easy to understand how the lagenostome could be dragged into the megaspore by post-mortem changes, it is difficult to see how the latter could be forced into the lagenostome either before or after the death of the seed.

V. Theoretical Suggestions.

Turning first to the integument, without entering upon the vexed question of its origin (which is not warranted by the present work), a word may be permitted on its more generally admitted homology with the inner layers of the Cycad integument. This was first pointed out by Oliver and Scott (**16**, p. 234), who consider that "the canopy may well have undergone simplification into the hard integument of a Cycadean seed," and suggest that the outer flesh of the latter with its bundles may represent the cupule. The interpretation of the Cycadean integument as a double structure (**18**) supports the view of its origin from the fusion of the two envelopes of a

Lagenostoma, though the author gives some reasons for regarding the stone layers as belonging morphologically to the outer flesh. In their recent excellent text-book (**6**, p. 128), Coulter and Chamberlain again draw a distinction between the stone layers in the two types, for while in the Cycad it is a "complex tissue several cells thick," in *Lagenostoma* it is "simply a modified epidermis." But if the facts given above (pp. 466–470) are accepted, this seems scarcely allowable as a description of the hard tissue in our seed. The reasons for regarding the hypodermal layer as consisting of hard fibres have been fully given, and it seems doubtful whether the well-defined epidermis was really hard at all; on the whole it is more suggestive of being glandular or secretory in its nature. However this may be, it would certainly undergo some modification after fusion with the cupule, as any excretory function would inevitably be lost, and it may quite well have become sclerified even if not originally so. This would perhaps explain why "differentiation and sclerification of the stone-cells start in the layers on the inner side and extend to an outward direction" (**18**, p. 564). At any rate there seems no decisive evidence against the derivation of the stone layers, though more elaborate, of the Cycadean seed from the hard shell of *Lagenostoma.*

Perhaps there is no more obvious, and at the same time interesting, question with regard to palæozoic seeds than the method of pollination, even if any attempts at an answer must for ever remain within the region of hypothesis. In the case under consideration, it seems very possible that the well-marked apical ridges were concerned in pollination, since no other organ, such as cone-scale, bract, or carpel, to aid in this function is known. They may conceivably have acted as the stigmatic rays of a poppy capsule, or the lines on the petals of a pansy, are supposed to do; but as it is scarcely certain that such lines are attractive to or guide insects in recent plants, and even less certain* that pollination of these seeds was effected by insects at all, this cannot be further pursued. But it seems to me possible that they, or rather the grooves they formed between them, promoted pollination in another way. Long ago Oliver showed (**13**, p. 461) that, "compared with the ordinary palæozoic type of seed, *Lagenostoma* seems peculiar in the lack of tracheal supply beneath its pollen-chamber"; and this statement is strikingly illustrated by the plate accompanying the paper (pl. 24), where the vascular system is seen in all the different seeds, recent or fossil, to approach the pollen-chamber except in *Lagenostoma.* The detailed examination of numerous specimens, many very well preserved, of two different species, permits us to reject the possibility that this deficiency is due to imperfect preservation; and if we also reject the hypothesis of the hydathodes and porous integument (p. 474), as there seems no structural

* See, however, Oliver and Scott, (**16**) p. 214.

evidence forthcoming in its support, we are still faced with the difficulty as to the source of the water which must have been required for fertilization. Is it not just possible that this was obtained from the exterior by means of the apical grooves? Any atmospheric water, rain, dew, etc. would be held by surface tension, and the tiny rivulets would tend to form a drop where they converge.

It is unfortunate in this connection that we have no indication as to how our seed was borne, but, to quote Oliver (p. 462), "whatever may have been the natural position of the seed (pendent or erect), a drop of water at the summit would inevitably be drawn into the narrow crevice of the pollen-chamber," and any pollen-grains on the apex of the seed would thus be swept along the grooves into the lagenostome. As already recorded (p. 478), one certain and several suggestive cases of pollen in the grooves have been found, all that could be expected to occur among the few sections passing through this region.

A very tempting hypothesis as to the method of pollination is that the dark, upper part of the nucellar cone was glandular and excreted a sugary substance to which the grains would stick, whether brought by wind or insects. But though there seems nothing directly to negative this possibility, there is, on the other hand, no evidence in its favour. The tissue is difficult to examine, but gives the impression of being thick-walled and without contents, which is not what one would expect to be the appearance of secretory tissue. A more probable function subserved by this organ is that of protection, against cold, desiccation, etc., of the delicate organs which lie beneath—particularly the growing embryo. We have physiologically analogous cases in the closing of the cone-scale after pollination in recent Gymnosperms, and in the obliteration of the micropyle at the same period in *Gnetum Gnemon*, recently described by Berridge (**3**) *. An even closer parallel is afforded by the approximation and hardening of the walls forming the "beak" in Cycadean seeds (**6**, p. 128). Of course it is not beyond the bounds of possibility that the apex of the central cone was at first glandular, and subsequently became modified to form, as it were, a stopper for the flask-shaped, pollen-containing organ. But while facts are lacking in support of the former hypothetical function, some evidence can be adduced in favour of the latter. In the first place, the very peculiar organization of *Lagenostoma* whereby the pollen-chamber projects beyond the integument in a seed that almost certainly, when mature, had no envelope of any sort extending over the micropyle, would suggest the necessity for some protective organ for the important structures which would otherwise be exposed to the outer air, invasion by fungus, etc. But

* The author suggests that the micropyle of *Bennettites Morierei* was blocked in a similar way, but this is denied by Lignier (**9**).

more direct support is given by the fact that the preparations, the planes of which pass through the neck of the lagenostome, usually show a close approximation of the wall of the organ with the apex of the cone. In R. 26 (Pl. **23.** fig. 12) this is so complete as to suggest that separation has never taken place. Here we are tantalized by the want of the next section, which would have passed across the base of the pollen-chamber and revealed whether or no it contained pollen. If such were the fact, it would show how completely the "stopper" had closed the aperture in this case. R. 21 *b* (Pl. **23.** fig. 14) is a similar, but more oblique, section across the neck of the lagenostome, which again shows the organ closed above; but here also we are faced with precisely the same difficulty—the section is a solitary one. Another preparation, R. 31, which also shows the closing of the lagenostome, is unfortunately but a fragment, and again we cannot be certain that it was pollinated. In the beautiful Battersea specimen (Pl. **23.** fig. 9)*, however, we have in a slightly oblique longitudinal section an almost completely closed lagenostome with a pollen-grain at the base on each side, proving that there must have been separation of the wall above, probably around the whole circumference †.

No other suggestion has, I believe, been put forward as to the significance of this distinct modification of the central cone, and we may therefore view appropriate sections with the above idea in mind till a better be forthcoming.

The vertical column of elongated cells extending from the "stopper" to the prothallus seems to correspond morphologically with the similar column described by Lang (**8**, p. 286) for the ovule of *Stangeria paradoxa*, and by Kershaw (**7**) for that of *Bowenia spectabilis*, but its function in *Lagenostoma* is somewhat obscure.

We now pass to the mode of formation of the pollen-chamber. Previous authors have spoken of the "separation" of the wall from the central cone, but they give no suggestion as to how this took place. In recent Cycads the pollen-chamber is formed by the disintegration of tissue in the apex of the nucellus; but in *Lagenostoma* the pollen-chamber is of a very different type, and we must attach some significance to the highly specialized wall. Moreover, careful examination of the outer edges of the central cone and the wall strongly suggests rupture as the cause of the separation, and nothing like mucilaginous degeneration. Some preparations (R. 30 *a*, R. 39, and

* The photograph was made from a slide in the Battersea Polytechnic Collection, for the loan of which I am indebted to Miss L. J. Clarke.

† The apex of the central cone is modified in a similar way in *L. Lomaxii.* The specimen R. 2 shows the "stopper" almost filling the neck of the lagenostome, as it could scarcely have done prior to pollination, which has obviously taken place. The section is figured in the paper (**11**) pl. 5. fig. 8 and pl. 9. fig. 21.

R. 46) show beautifully the torn cell-walls, and it is difficult to explain these appearances on the degeneration hypothesis. It seems to me highly probable that the wall, with its strongly thickened bars, was hygroscopic, and split from the central soft tissue with alteration in atmospheric humidity. If this were the case, since the wall is never itself ruptured, there must have been considerable increase in its circumference. This is, however, allowed for by the curved outer walls. For example, let us consider the Manchester specimen, since this has the double advantage of being cut transversely across the middle of the lagenostome, and of showing the structure of the wall remarkably well. Now the circumference of the wall in its present collapsed condition is 1·9 mm., but if its radius were to be extended by (say) 80 μ (*i. e.*, so that a pollen-grain could easily get in at any point) *, the circumference would have to be increased to 2·5 mm. If, however, the curved outer walls were straightened out, the circumference would reach 2·8 mm., so that there is no trouble on this score. But if the wall expanded to its full extent, or even considerably less than that, it could not remain circular, because it would almost immediately encounter the cusps of the canopy lining. This possibly explains the bevelled wall of the lagenostome, which to my mind is not an inherent structural feature, but is impressed upon the wall by its close contact with the hard canopy lining during expansion. The fact that the wall is not so bevelled lower down, where it has plenty of room to expand in the sinus between it and the canopy, supports this view.

Coulter and Chamberlain state that the pollen-chamber is formed from below upwards, basing their view apparently on a single section (figured p. 34) where the central cone is free from the wall below, but in contact, and presumably in continuity, above. In the University College Collection there are, however, sections which, while not so good in some respects, are similar in that the central cone is to all appearance united to the wall above and free below. But these sections (*e. g.*, R. 43, R. 56) contain pollen, which, while it does not prove that the dehiscence was not in the affirmed direction, shows that an appearance such as that described is fallacious as evidence of the fact. Before seeing their account of *Lagenostoma*, I had come to the conclusion that the pollen-chamber was very likely formed from below upwards. This view is based on the consideration that the plinth was probably concerned in dehiscence. It will be remembered that the structure of this organ is similar to that of the lagenostome wall, and, since it is firmly united to the canopy, the smallest hygroscopic contraction would immediately rupture its connection with the central cone, especially as the curved fibres would tend to straighten

* Assuming that the central cone nearly touched the wall, as it does normally. In this specimen it has been dragged down, and is therefore of much smaller diameter than the wall.

at the slightly constricted junction of the plinth with the lagenostome wall. But whether this took place first or last is a small matter compared with the necessity that dehiscence should be secured right to the base so that the sperms might have free access to the archegonia. Complete circumscissile dehiscence was not absolutely necessary and did not seemingly always take place, except at the base, where we have an organ specially modified to secure it

Finally, a word may be added on the morphology of the lagenostome. It is generally admitted that this unique structure is no doubt the modified apex of the nucellus, and indeed it is difficult to see to what else it could be attributed. Now the nucellus is an enclosed, more or less specialized, megasporangium, and we do not lack fern sporangia showing features which suggest the type that may well have formed the basis for such specialization. The sporangia of *Angiopteris*, *Osmunda*, and *Schizæa* all have apical or sub-apical annuli, of which genera *Osmunda* is particularly interesting, since it is a synthetic type combining in itself several of the characters of the eu- and lepto-sporangiate ferns. But in the fossil *Senftenbergia* we find what would seem a closer parallel in a multiseriate, apical annulus. The time needed to evolve other features of our seed, such as the integument, is at least sufficient for the modification of such a type as *Senftenbergia* into the nucellus of *Lagenostoma*, from which it is surely not so far removed in form or function *.

The comparison very tentatively put forward by Lang (**8**) between certain thickened cells in the microsporangia of *Stangeria paradoxa* and the annulus of the Schizæaceæ, and further between the micro- and macrosporangia of the former, is strengthened by the hypothesis of the retained annular dehiscence in *Lagenostoma*, the mechanism for which is perhaps vestigial in its nearest ally among recent plants—the Cycad ovule, *cf.* (**8**) p. 302.

It has already been suggested (**10**) that the tracheal mantle at the periphery of the nucellus—so common a feature in fossil Gymnosperm seeds—is homologous with the vascular tissue found within the wall of a fossil sporangium. There is surely no greater difficulty in deriving the wall of the lagenostome from the annulus of another fossil sporangium. Both are specialized parts of the sporangium wall: and here too, as in the analogous case just cited, there would be some change of function "in harmony with the modified fate and enlarged functions of the macrosporangium"; for, whereas in the ancestral fern sporangium dehiscence was effected to let the contained spores out, in the megasporangium it takes place in order to let the microspores in.

If there is any truth in this surmise, the Lyginodendreæ have preserved

* The suggestion is put forward as much for *L. Lomaxii* as for *L. ovoides*; for though not so well marked as in the latter, the former species shows the radial thickenings, and even the curved outer walls, while the inner tangential walls are generally retained. The transverse section of the lagenostome wall in R. 16 *b* is, to me, remarkably suggestive of an annulus.

for us another link with their Pteridophytic origin, even in those organs which raise them to a higher phylum—their seeds.

February 1912.

I wish to thank my friend Mrs. Hatfield for her sympathy and help in my work.

To Professor Oliver I owe not only individual help and criticism, but the stimulus his work must afford all who attempt to labour in the realm of fossil seeds.

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EXPLANATION OF THE PLATES.

b. = blister.
c.p. = central papilla.
c.c. = central cone.
ch.pl. = chalazal plate.
e. = epidermis.
f. = fibrous layer.
fl. = fluted lining of canopy.
g. = germinal tube.
gr. = groove.
l. = loculus.
l.w. = lagenostome wall.
m. = megaspore membrane.
n. = nucellar membrane.
mi. = micropyle.
o.s. = outer shell.
p. = prothallus.
p.c. = pollen-chamber.
p.gr. = pollen-grain.
pl. = plinth.
r. = ridge.
sp. = spore.
s. = septum.
si. = sinus.
s.s. = secretory sac.
s.t. = soft tissue.
stp. = stopper.
v.b. = vascular bundle.

PLATE 22.

Fig. 1. *a* and *b* cells from the fibrous layer of R. 20 *a* (1). *a* illustrates the way the "contents" of *b* are derived. *Cf.* p. 469. *c*=cells from the fibrous layer of R. 21, *a* showing special type of preservation. × 360.

Fig. 2. Part of the wall of the seed of fig. 27 enlarged. The position of the portion drawn is indicated by the reference lines *e.* and *v.b.* Note the differentiation of the cells of the fibrous layer occurring opposite the bundle, which is torn away. R. 22. × 300.

Fig. 3. Portion of epidermis in surface view to show appearance suggestive of original continuity of protoplasts. R. 26 (fig. 12). × 360.

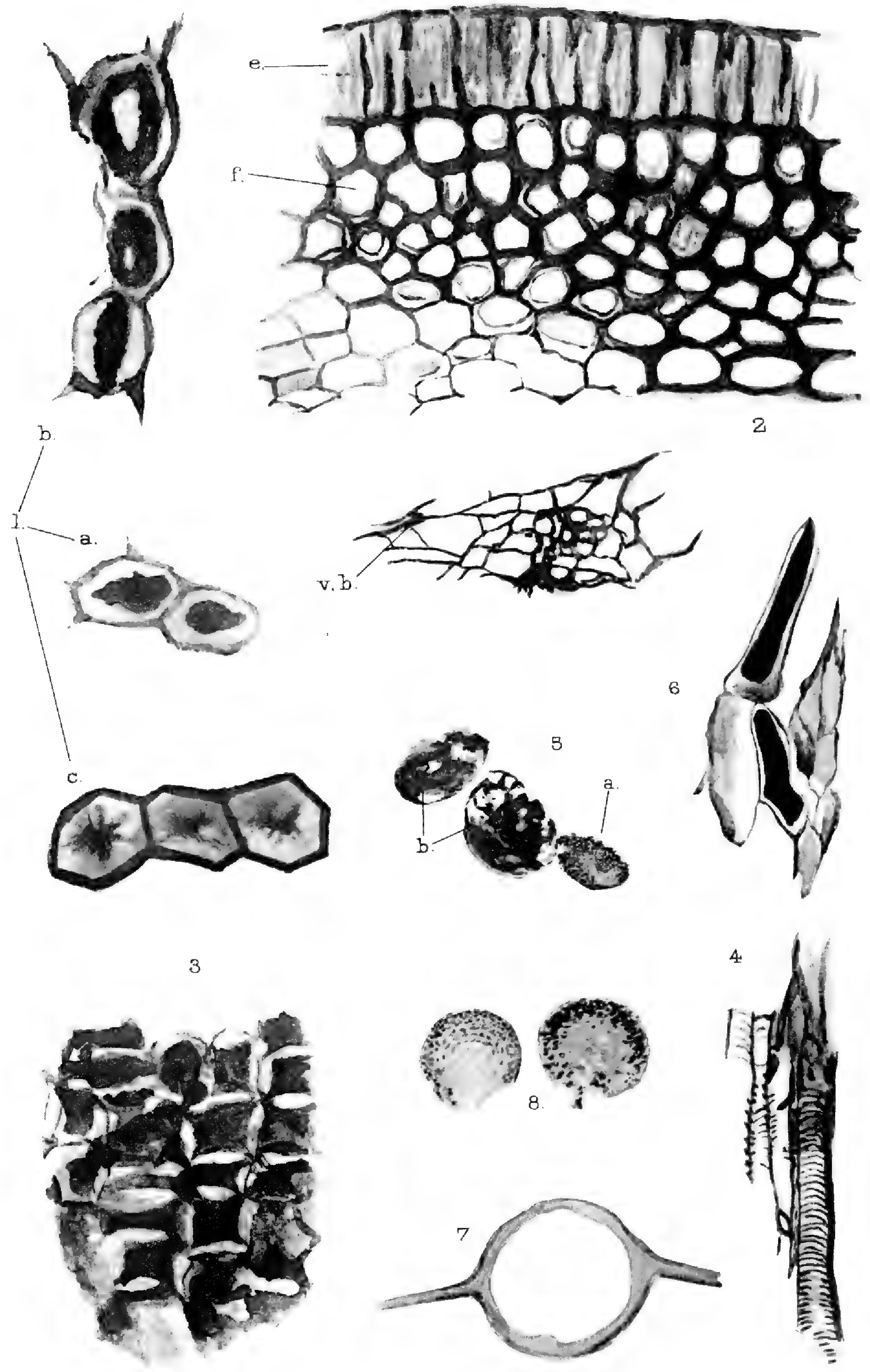
Fig. 4. Part of vascular bundle cut longitudinally about half-way up the seed (*cf.* p. 474). R. 48 (1). × 360.

Fig. 5. Two pollen-grains and a body of unknown origin from the pollen-chamber of R. 38. × 168. *Cf.* p. 478.

Fig. 6. Two secretory sacs from the base of R. 41 (2). × 360.

Fig. 7. Fungal spore (or vesicle) occurring in the crushed seed in R. 46. × 770.

Fig. 8. Another type of fungal spore from R. 52. × 770.



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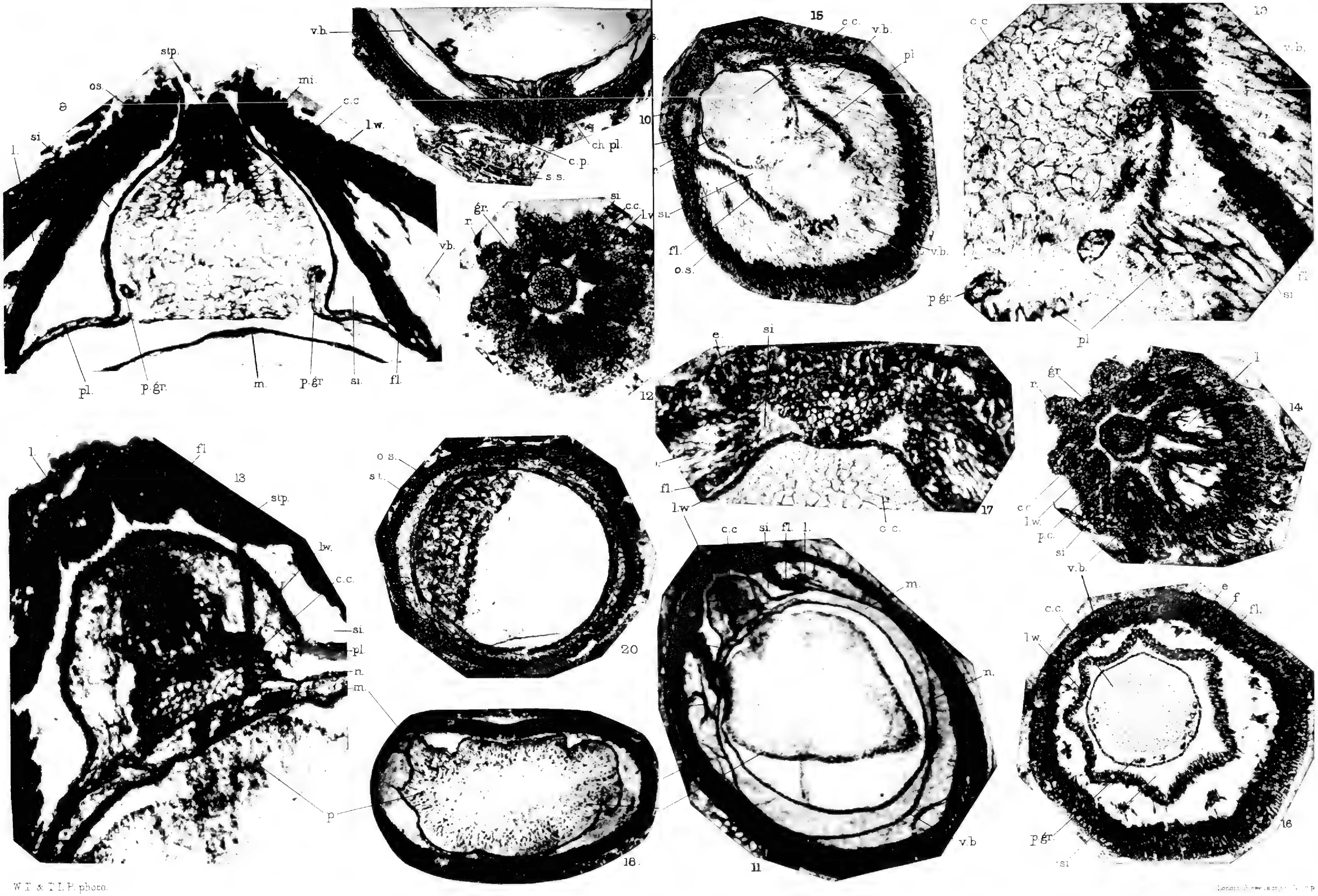
LAGENOSTOMA OVOIDES.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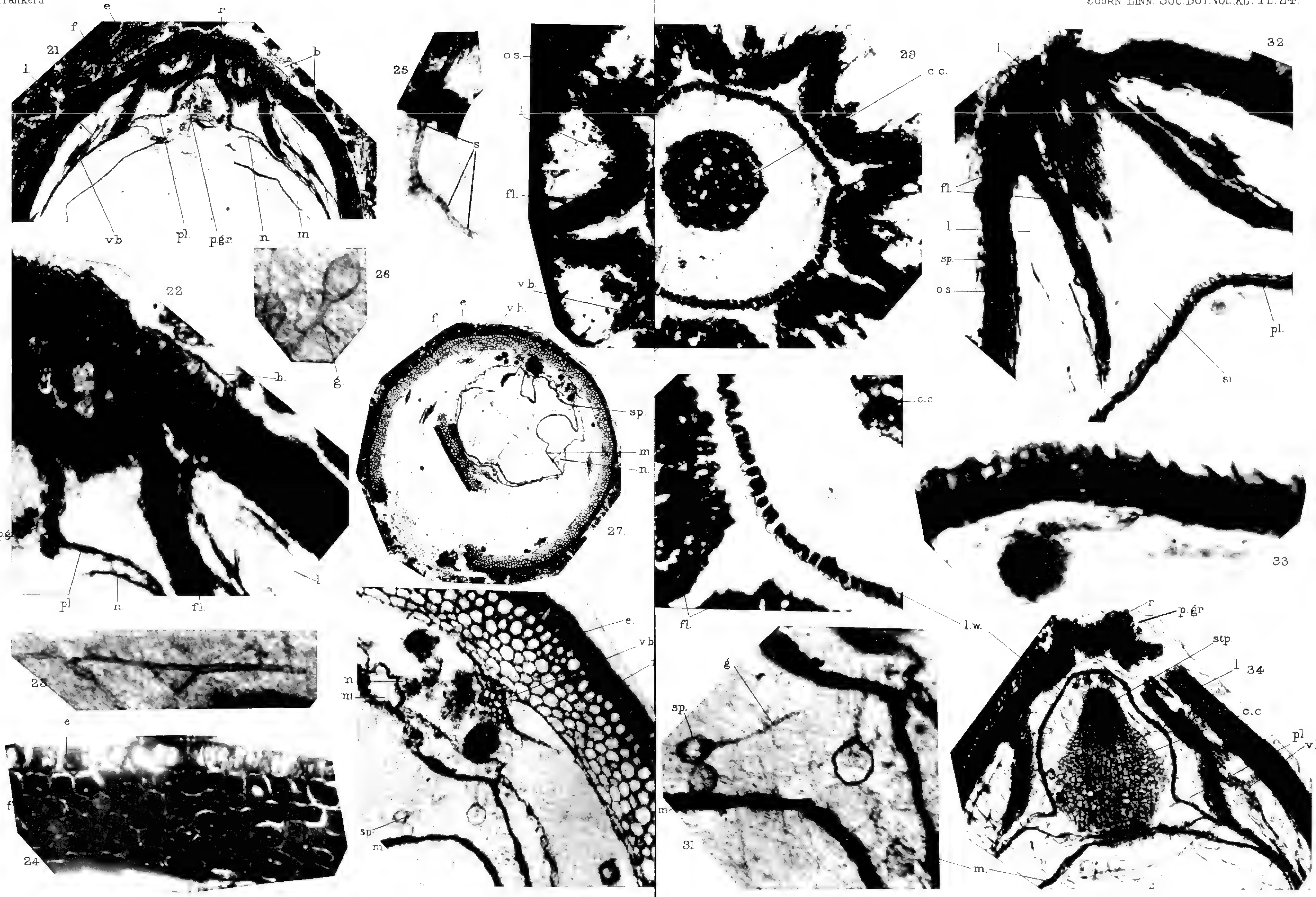
W. T. & T. L. P. photo.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c.c.
33
fl.
l.w.
r
p.gr
stp.
l
34
c.c.
pl
v.b.
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23
e
f
24
e.
vb
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m.
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PLATE 23.

Fig. 9. Upper part of oblique longitudinal section passing through the micropyle. Note the papillate epidermal cells at the apex, the projection of the lagenostome beyond the micropyle, and the almost complete closing of the pollen-chamber by the "stopper" (p. 484). B. 8. × 70.

Fig. 10. Lower part of oblique longitudinal section passing through the central papilla at the base of the seed. In the débris (probably a pinnule) just beneath the seed secretory sacs occur similar to those found in the seed (*cf.* p. 471). R. 48 (2). × 38.

Fig. 11. Oblique longitudinal section showing the prothallus with dark cell-like masses round the edge (*cf.* p. 479). This seed is infected with fungal hyphæ better shown in fig. 13. R. 29. × 23.

Fig. 12. Oblique section across the apex of the seed showing the ridges and grooves and the closed (or unopened) lagenostome (*cf.* p. 484). An enlarged drawing of part of the epidermis is given in fig. 3. R. 26. × 48.

Fig. 13. Enlargement of the lagenostome of fig. 11 to show fungal hyphæ. R. 29. × 85.

Fig. 14. Section across the apex, more oblique than fig. 12, showing the bevelling of the lagenostome wall, and, to the right, the pollen-chamber, also the vascular bundles traversing the loculi. R. 21 *b*. × 40.

Fig. 15. Oblique section through the lagenostome and canopy of a beautifully-preserved seed. Figs. 17 and 19 are from the same section, and fig. 20 from the same seed. R. 20 *b* (2). × 32.

Fig. 16. Somewhat oblique transverse section through the canopy and lagenostome. Note the double loculus to the right with two vascular bundles; also the group of smaller cells in the middle of the central cone. R. 20 *b* (1). × 33.

Fig. 17. Apex of fig. 15 enlarged. R. 20 *b* (2). × 105.

Fig. 18. Partially crushed section across the body of the seed, to show what is believed to be the first stage in the formation of the prothallus (*cf.* fig. 11 and p. 479). R. 24. × 18.

Fig. 19. Base of lagenostome and plinth of fig. 15 enlarged. Note junction of plinth and lagenostome wall, and the sharp outlines of the torn cell-walls at the edge of the central cone. R. 20 *b* (2). × 125.

Fig. 20. Section at base of seed from which fig. 15 is taken. (The darkened part to the left of the space within the wall is not organic, but due to the structure of the mineral.) R. 20 *a* (2). × 23.

PLATE 24.

Fig. 21. Upper part of oblique longitudinal section passing through the pollen-chamber. Shows a micropylar ridge overlying a septum, and two "blisters" on the epidermis. R. 41 (1). × 30.

Fig. 22. Part of fig. 21 enlarged to show "blisters," and exfoliation of cuticle a little higher up (*cf.* p. 467). R. 41 (1). × 90.

Fig. 23. A branched fungal hypha from the cavity of the seed in R. 49. × 470.

Fig. 24. Transverse section across a piece of the outer shell of the seed occurring in R. 36. × 176. Note thick laminated walls and *cf.* with fig. 28.

Fig. 25. Septate hypha occurring close to the apex of the seed in R. 40 (1). × 340.

Fig. 26. Spores germinating in the body of the seed R. 49. × 470. In one case the germinal tube has already branched twice (*cf.* p. 479).

Fig. 27. Transverse section across the body of the seed near its base, showing the thin-walled type of preservation of the fibrous layer, the slight angling of the shell, and the eight vascular bundles—some of which are *in situ*. R. 22. × 24. Parts of this section are shown enlarged in fig. 2 and photo 28.

Fig. 28. Piece of fig. 27 near "*sp.*" enlarged. Shows bundle *in situ* and germinating spores. R. 22. × 120.

Fig. 29. Transverse section across the canopy and lagenostome to show the structure of the lagenostome wall. M. 755. × 83. The central cone has been dragged downwards, so that only the "stopper" is cut through. *Cf.* fig. 34.

Fig. 30. Part of fig. 29 between reference lines *l.w.* enlarged to show wall of lagenostome in greater detail. M. 755. × 154.

Fig. 31. Germinating spores of figs. 27 and 28 enlarged. R. 22. × 250.

Fig. 32. Upper part of oblique longitudinal section cutting the plinth tangentially. R. 49. × 63.

Fig. 33. Central part of plinth in fig. 32 enlarged to show detail. The dark mass below is probably fungal in origin. R. 49. × 240.

Fig. 34. Upper portion of oblique longitudinal section showing apical grooves, in one of which a pollen-grain is seen. R. 30 *a*. × 45.

Note on the Internodes of *Calamites*. By Prof. PERCY GROOM, M.A., D.Sc., F.L.S. With some Observations by F. J. LEWIS, D.Sc., F.L.S.

(With 4 Text-figures.)

[Read 7th March, 1912.]

SEVERAL botanists * have supplied records of Calamite-stems showing the recurrence of short internodes separated by a number of longer ones, and Williamson drew special attention to such a recurrence at intervals of eight and five internodes respectively in two specimens. One feature worthy of note is that in a number of specimens the branch-scars are inserted exclusively in contiguity with these short internodes. Horwood (*loc. cit.*) points out that the gradual increase of length of the successive internodes, commencing at one of the short ones, is paralleled by similar features in the stems of modern Equiseta.

So far no explanation of this rhythmic succession of internodes on Calamite-stems has been offered, except the teleological one presented by Horwood, according to whom "the short internode appears to serve the purpose of imparting additional strength to the stem owing to the weight of branches above." This explanation, so far as I understand it, is placed out of court not only by the occurrence of similar characters in bamboos and dicotylous plants, in which the branching is not necessarily correlated in position with short internodes, but also by Horwood's observation that *Equisetum sylvaticum* and *E. litorale* display a similar internodal periodicity—for in these two species branches occur at all cauline nodes.

Modern Angiospermæ seem to supply the answer to the problem, for in them, so far as is known, each rhythmic cycle of internodes in the vegetative region of the stem corresponds to the increment in length of this during a single growing season; and normally there is one such season in each year. It is necessary to note several features concerning the rhythm of these plants, if they are to be used as evidence in regard to *Calamites* :—

1. The internodal rhythm of modern dicotyledons, though liable to some disturbance by external factors, is of regular type and more or less characteristic of the species, as is best shown graphically by means of an internode-curve †. In at least a great number of species the successive internodes

* For literature see: A. R. Horwood, "On *Calamites Schützei*, and on the Correspondence between some new features observed in *Calamites* and Equisetaceæ." Journ. Linn. Soc., Bot. vol. xxxix. 1910, pp. 277–89; W. Jongmans: "Beiträge zur Kenntnis von *Calamites undulatus*, Sternb." Med. v.'s Rijks Herbarium, Leiden, 1911, pp. 43–59.

† Percy Groom: "Longitudinal Symmetry in Phanerogamia." Phil. Trans. London, B. vol. 200, 1908, pp. 57–115; "The Longitudinal Symmetry of the Centrospermæ." Trans. Linn. Soc. ser. 2, Bot. vii. 1909, pp. 267–302

produced during one vegetative season, and constituting either the main stem of a herb or the year's long-shoot of a woody plant, show a regular rise in length, succeeded by a fall. This rhythm is inherent, and occurs whether the stem bears its strongest branches at the base, middle, or apex. (Some arboreous species display in their year's shoot two internodal "cycles": this is associated with the production of a second crop of leaves in one season.)

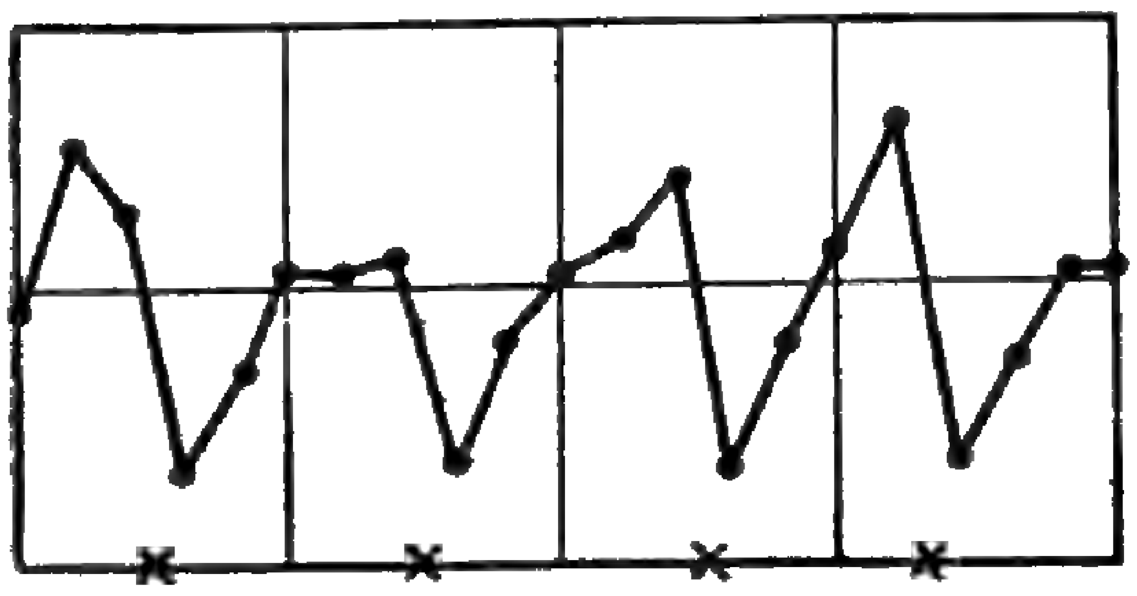
2. In trees the strongest and largest lateral buds, destined to produce the strongest branches, are usually inserted nearest to the top of the year's shoot, a climax being reached in such types as the pines, where all the lateral buds responsible for the production of long-shoots form a false whorl immediately beneath the top of the year's shoot. In shrubs the strongest buds are usually inserted near the base of the year's shoot. Whilst in some trees, especially those with a shrubby or weeping tendency, the insertion of the strongest buds is apt to be intermediate between the extremes just denoted.

3. Just as the successive internodes wax and usually wane in size on the year's shoot so likewise do the leaves on this, an extreme in the reduction being reached in the scale-clad terminal buds of woody plants. It should be noted that the curves representing the dimensions of the successive leaves and internodes of a year's shoot do not necessarily synchronize as regards phase. These changes in the dimensions and shapes of the successive leaves result in more or less distinct corresponding differences in their scars.

The question arises: "Do the Calamite-stems conform in all three respects with the woody stems of dicotyledons?" In the succeeding paragraphs are described the results of the three types of tests applied to those specimens of Calamite-stems that have sufficiently numerous internodes and sufficiently distinct scars of buds or branches and leaves. And, to anticipate, it may be stated that the conclusion to be drawn from the available statistics is that these strongly suggest that each cycle in the characteristic rhythm in Calamite-stems corresponds to one season's growth in length.

I. *Regularity of the Period (Cycle) of Internodes of Calamite-stems.*

CURVE I.
Calamites Schützei: measurements are in centimetres.



In the following Tables, each referring to one stem only, the successive internodes are ranged from left to right in horizontal series, each complete horizontal line representing one assumed cycle and one season's growth in length. B denotes the position of the branches. Thus the vertical series in a Table represent in a sense homologous internodes.

Calamites Schützei (measured by Horwood). Curve I.

	1	2	3	4		5	Total length.
1st cycle	..	47	78	63	B	16–19	Incomplete.
2nd „	35–38	52	52	55	B	19	216–213 mm.
3rd „	41	52	58	71	B	19	241 mm.
4th „	40	57	82		B	19	198 mm.
5th „	38	52	52	..	..	..	Incomplete.

The cycles (periods) in the preceding Table do not correspond with those as defined by Horwood; the reason for the changed grouping will be seen hereafter.

In Curves I., II., and III., the crosses on the base-line denote the points of insertion of the branch-scars.

Calamitina varians, var. *insignis* (measured by Kidston). Curve II.

	1	2	3	4	5	6	7	8	9	10	11	12		13	Total.
1st cycle..	..	..	..	..	..	..	..	..	..	..	22·5	19	B	9·5	Incomplete.
2nd „ ..	5	6·5	9·5	8·5	10·5	11	11·5	12	12·5	12	11	8	B	7·5	125·5 mm.
3rd „ ..	3·5	4	4·5	5	7	7·5	7·5	8	8	8·5	6		B	7	76·5 mm.
4th „ ..	3	3	3·5	4	3	5	4·5	5·5	6·5	5	8·5	..	..	..	Incomplete.

Calamites undulatus (measured by W. Jongmans and illustrated by his Figure 4). Curve III.

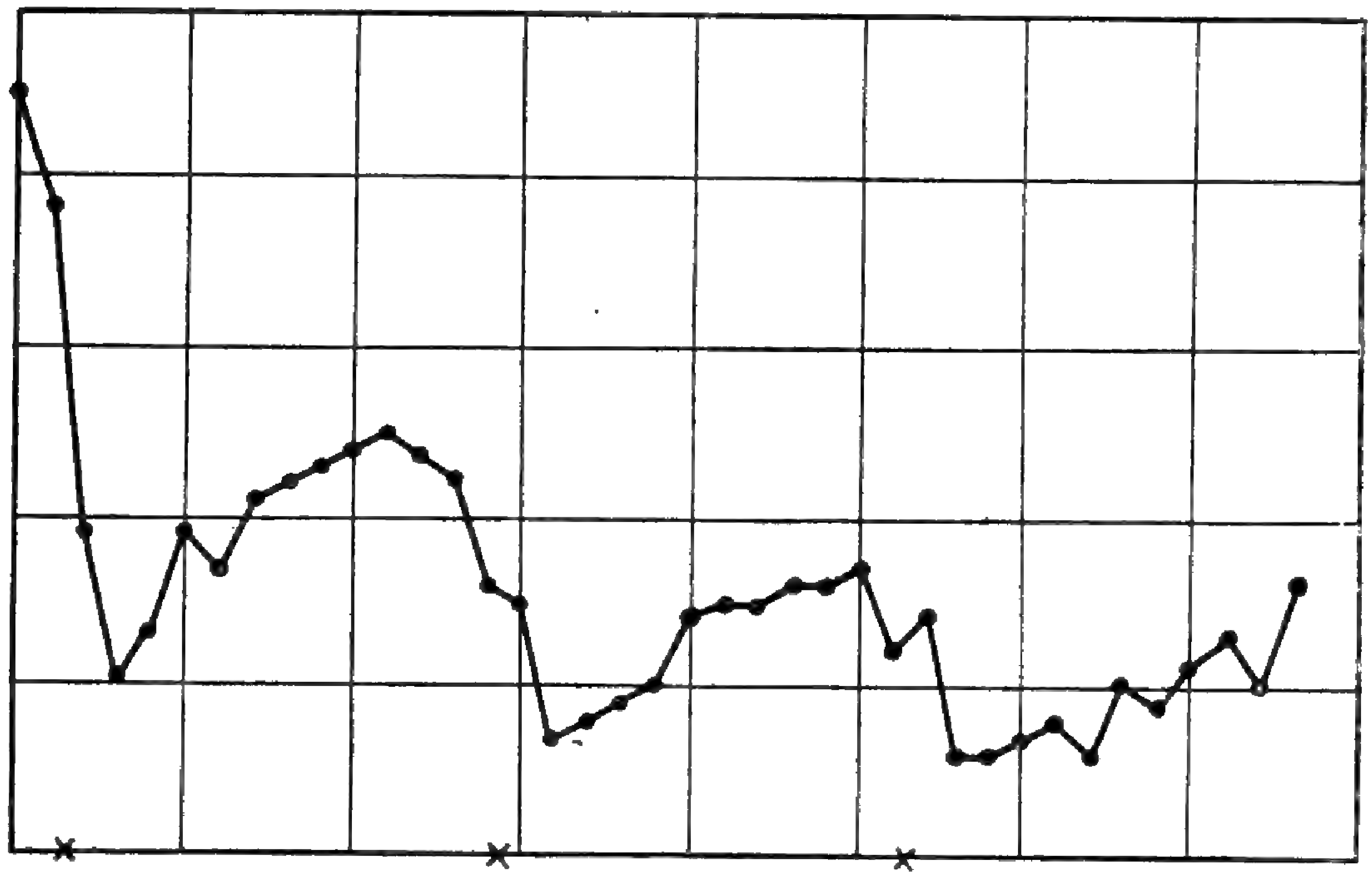
	1	2	3	4	5	6	7		8	Total.
1st cycle	..	..	..	..	..	..	..	B	18	Incomplete.
2nd „	28	40	44	42	48	40	..	B	17	259 mm.
3rd „	30	42	47	57	58	60	64	B	18	376 mm.
4th „	37	..	..	..	..	..	..	..	..	Incomplete.

The forms of the Internode-curves I., II., III. show that those parts representing the respective cycles (or periods) in each specimen largely agree in general form and regularity.

En passant it may be noted that the commencement of Curve II. shows that the stem of *Calamitina varians* could increase in length in one season by a number of millimetres much larger than 125 millimetres. *Calamites Schützei* and *C. undulatus* show increments in length of 240 and 376 millimetres respectively in one season. These statistics, though interesting as giving, for the first time I believe, an estimate of the rate of growth in length of fossil stems, obviously tell us nothing of the mean or maximum rate of

CURVE II.

Calamatina varians, var. *inconstans*: measurements are in millimetres.



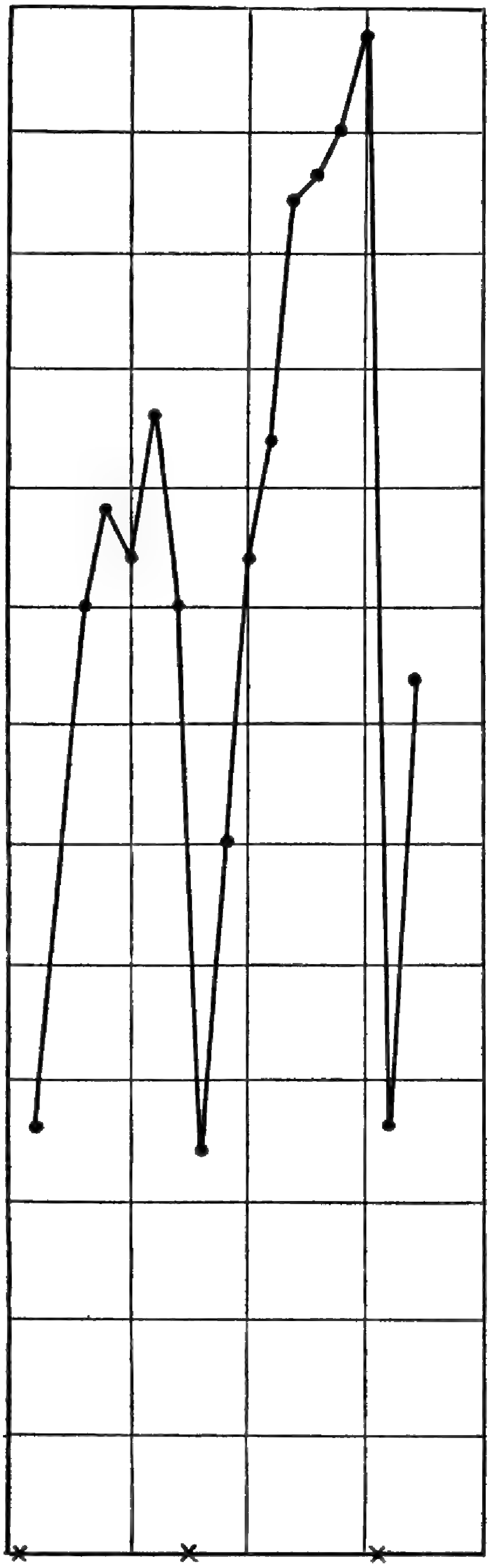
growth of the species. The other measurements supplied by Kidston, Jongmans, and others, are not sufficiently numerous to allow of comparison of two or more cycles.

II. *Insertion of the Branch-scars, and their dimensions.*

In the specimens of which measurements have already been given here, the correspondence between the position of the branch-scars and the length of internodes is obvious. According to the scheme here presented, the branch-scars occupy the same position as strongest buds or branches of trees. This scheme is nearly certainly correct for *Calamitina varians*, the other alternative being the occurrence of two internodes above the insertion of the branch. The matter is more doubtful in the cases of *Calamites Schützei* and *Calamites*

undulatus, yet as grouped according to this scheme all three agree in having the branches at the penultimate node, and in thus conforming with the typical tree-habit.

CURVE III.
Calamites undulatus: measurements in millimetres.



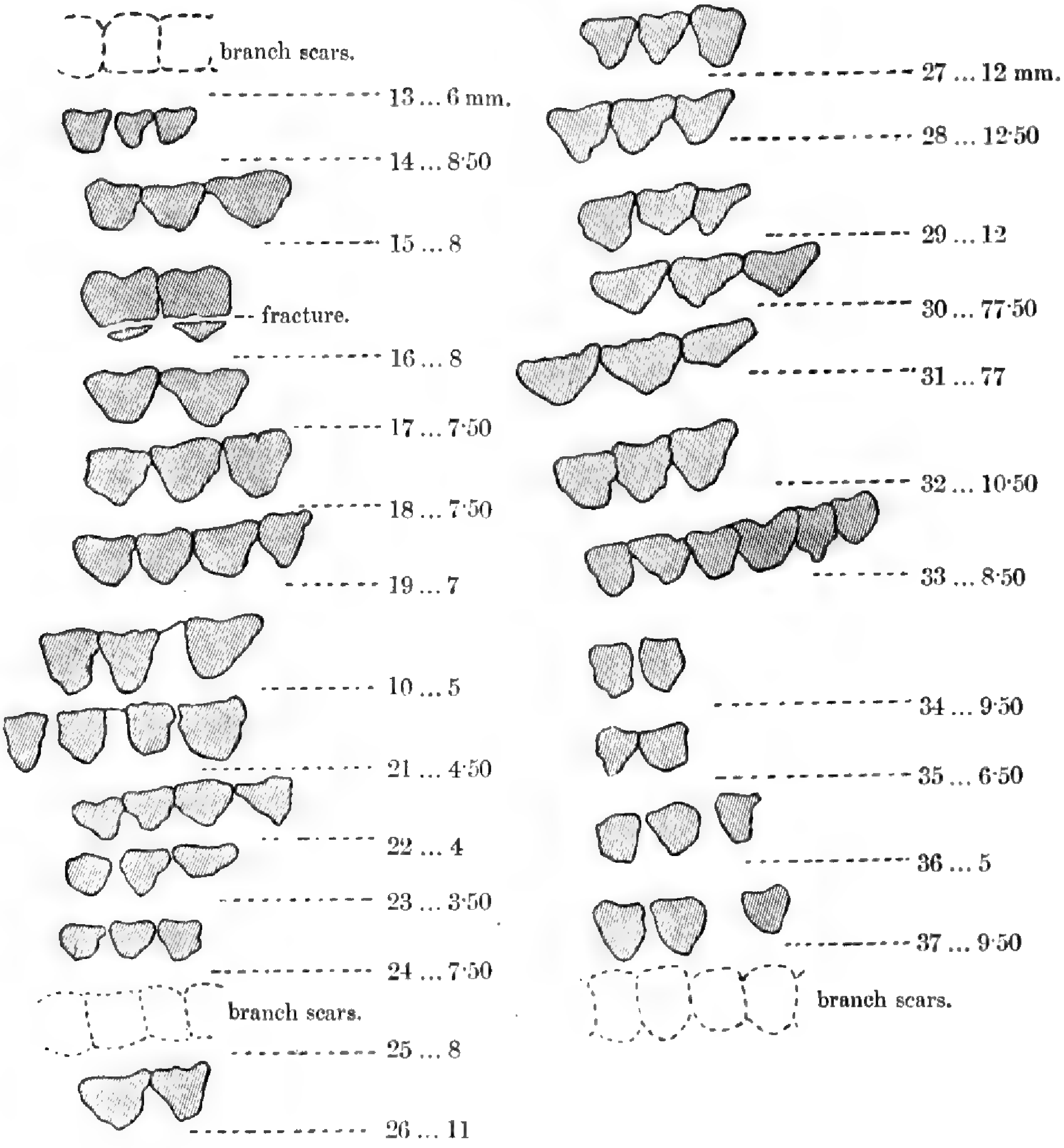
Other specimens of *Calamites undulatus* described by Jongmans show the branch-scars specially in the neighbourhood of the shortest internodes.

Very interesting confirmatory evidence is supplied by Jongman's specimen "i" of *C. undulatus*, of which he gives a diagram (Figure 12 in his paper). This shows branch-scars at all the nodes, but the scars at the base of the shortest node are conspicuously larger than those at the other four nodes. Such would be the normal condition on the year's shoot of trees in which a short internode is near the tip.

III. *Nature of the Leaf-scars on* Calamites.

I could find no information as to the dimensions or shapes of the leaf-scars in the measured *Calamites*, yet it seemed possible that investigation of the specimen described by Kidston (*Calamitina varians*, var. *inconstans*), with its numerous nodes, might show variations similar to those in the year's shoot of modern plants; and in particular that the leaf-scars in the middle of each cycle might be larger than and of a different shape from the others. Dr. F. J. Lewis was so good as to examine the specimens from this point of view, and his observations, which are appended, clearly prove that such is the case. In this connection it may be mentioned that Horwood's measurements of the leaf-sheaths of living Equiseta show a gradual increase in the length as the stem is ascended.

Fig. 1.



Two complete periods in *Calamatina varians*, var. *inconstans*, in the Ravenhead Collection, Liverpool Museum, showing variations in size and shape of leaf-scars in successive whorls.

In each series the right column of figures refers to the length of the internodes as given by Kidston, the left hand column gives the internode number. ×8.

OBSERVATIONS by Mr. FRANCIS LEWIS on *Calamitina varians*, var. *inconstans*.

This specimen, which is in the Ravenhead Collection, Liverpool Museum, has been fully described by Kidston * under the name of *Calamitina varians*, Sternb., var. *inconstans*, Weiss. The specimen measures about 32 cm. in length, and shows two complete and two incomplete periods. Kidston's description does not contain any reference to variations in the shape or size of leaf-scars in different parts of the same period. He describes the leaf-scars as transversely oval or sub-triangular, and mentions a note by Dr. Weiss, Berlin, that the sub-triangular form of the leaf-scars may be the result of pressure bringing about a slight distortion.

An examination recently made by me of all the clearly defined leaf-scars in this specimen shows that certain variations in size and shape do occur in different regions of the same period.

The two complete periods exhibited by this specimen were examined and the leaf-scars drawn with a Zeiss *camera lucida* under a magnification of 8. Owing to the variation in shape of the scars, and the fact that in some cases the margin is not very clearly defined, it is difficult to express the variations in figures, but the changes in shape and size are shown in the accompanying figure (Fig. 1).

The leaf-scars in the lower period show a gradual increase in size from the whorl next above the lowest branch-scar up to the 6th and 7th nodes. From here a slight decrease takes place, the leaf-scars of the 11th node being smallest, and the scars of the 12th node at the end of the period being slightly larger.

In the upper period the changes are more definite. The 1st node in the 2nd period shows small leaf-scars; from here the size rapidly increases, reaching a maximum at about the 5th node. The 6th node shows slightly smaller scars, the 7th, 8th, and 9th are nearly of the same size, but the 18th and the 11th at the end of the period show a rapid decrease in area, the 11th next below the branch-scar being the smallest.

* Trans. Roy. Soc. Edin. vol. xxxv. p. 391, 1890.

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[Synonyms and native names are printed in *italics*. A star * denotes the first publication of a name.]

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